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CONTENTS.—See Page VII.

The Coming Total Eclipse.

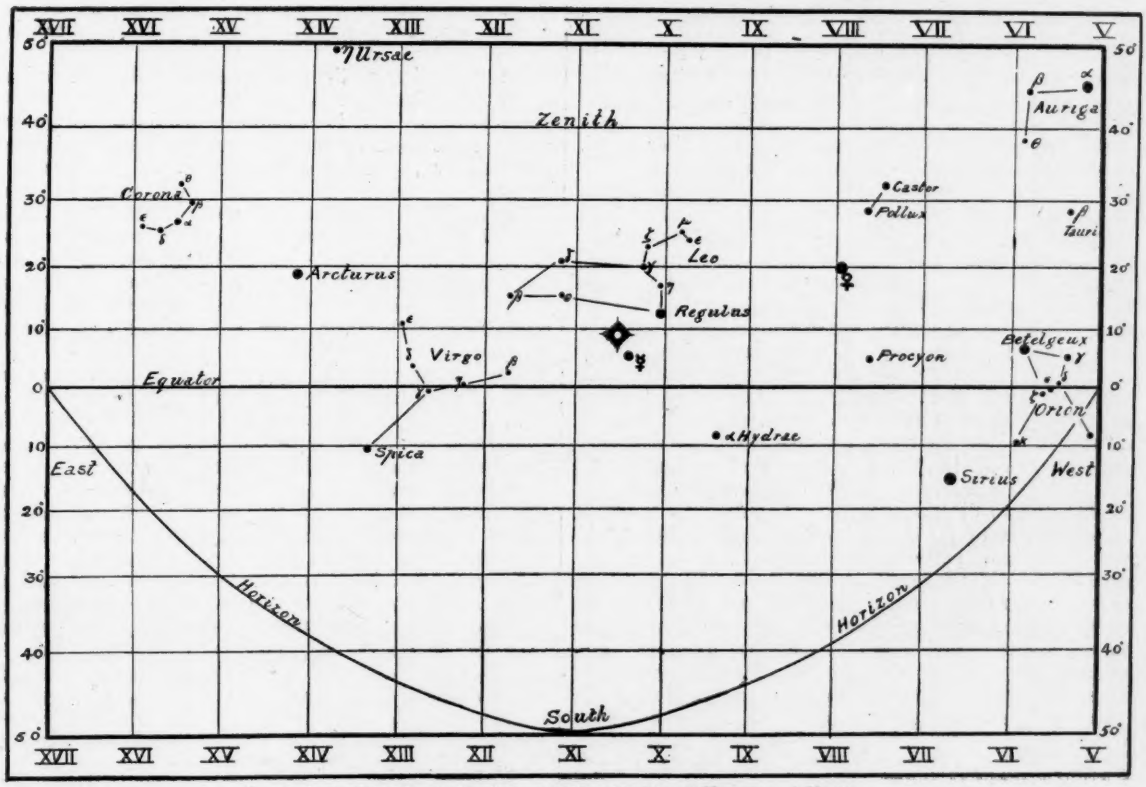
By W. SHACKLETON, F.R.A.S.

IN addition to registering the corona on the photographic plate, bright stars included in the field of view of the lens may be recorded.

The sun will be situated in the constellation Leo, about 8° S.E. of Regulus. The chart given below shows the aspect of the sky at the time of the eclipse. It will be seen that it is the same as the evening sky near the middle of the present month about 9 p.m. Mercury will appear in close proximity to the sun, being about 3¼° to the S.W.; the eclipse taking place only 10 hours after *inferior* conjunction of the planet with the sun, thus he will appear as a very delicate crescent. Venus is situated about 39° to the west, and is gibbous.

Observers provided with telescopes could not do better than confine their attention to the examination of coronal detail in the neighbourhood of prominences or near the poles.

Quoting from the British Astronomical Association's Report of the eclipse of 1900: "In spite of the diffusion of photography, it may well be that in the future from time to time an observer may find himself at a total eclipse with a telescope, but without photographic appliances. There will be still work for him to do in such a case; and in any case we cannot assume, until we have both telescopic scrutiny and photographic records throughout all the varying phases of a complete solar



Aspect of the sky at the time of Eclipse (Spain). ☿ Mercury. ♀ Venus.

cycle, that the more complex and elaborate structure of the corona at the sunspot maximum may not give to telescopic examinations greater minuteness of detail than any but exceptional photographs can supply."

In recent eclipses the best photographs taken with the prismatic camera show that the images of the corona in 1474 K light are not smooth rings, but rings having a definite form not necessarily coinciding with the outline of the corona as photographed in ordinary cameras, but probably recording a true *inner* corona composed of the unknown gas *coronium*. The disentanglement of this "inner corona," or that part giving *coronium* emanations and self-luminous, from the *outer* corona, which is composed of particles or droplets, and luminous chiefly by its reflective power, is a difficult problem, since even in an eclipse it is the enveloping atmosphere and not a section of it which is presented to us. Here it seems to indicate that advantage must be taken of the outer corona giving a continuous spectrum, whilst the inner corona gives a line spectrum with its principal radiation in the green, the "corona line." If, then, a light filter be employed

Coronal detail round prominence. (Eclipse, 1896.)

which only allows this green light to pass through in effective quantities, one may succeed in photographing the inner corona alone, and thus determine the distribution of *coronium* in the corona. Gelatine films stained with aniline blue and tartrazine form a light filter of this nature; but even this may prove insufficient by itself, and possibly the spectroscope will have to be called in as an additional aid. Suppose, then, a prism from an ordinary spectroscope be fixed in front of the lens of the camera, thus making a small prismatic camera which can be accurately focussed by allowing Polaris or a bright star like Vega to trail and impress its spectrum on the plate; when this is pointed to the eclipsed sun a series of rings partially superposed will result from the radiations of the inner corona, whilst the light of the outer corona will be spread out as a continuous spectrum, and consequently enfeebled at any one point; hence, by the interception of a light filter as above described, one may possibly prevent all but the bright green ring from leaving any record. Another suggestive method, which will enable one to discriminate between these two kinds of radiations, is to take advantage of the fact that light reflected from particles is polarised, and thus, by attaching a Nicol prism in front of the lens, and making several exposures on the corona with the Nicol at various known degrees of rotation, one may be able to sift out the two kinds of radiations. A polariscope opera glass, with the Nicol between the eye and the eye lens, somewhat similar to the prismatic opera glass, would be of service as a supplementary aid. The distribution of *coronium* is a long-standing problem, and, quoting from Professor Eastman's report of the total eclipse of 1878, he says: "The limits of all the known coronal elements should be carefully determined by measurement, at each eclipse, and then the study of one important branch of solar physics will rest on definite data. The existence of the 'green line' has been established for several years, and it is a waste of valuable opportunity to stop at simply saying it was seen." The spectrum of the corona requires in general to be studied with a more powerful equipment than that so far considered. Some observers have reported no Fraunhofer lines in the spectrum of the outer corona, but it would have been more surprising if they had been seen when we learn what apparatus was employed. It is important, therefore, to devote certain apparatus to particular work; negative evidence is valuable if obtained with suitable instruments, otherwise it may be misleading. Adequate instruments does not necessarily mean "big," for, referring to the case above, an observer with a powerful spectroscope would in all probability record the absence of Fraunhofer lines, whilst another with a less powerful piece of apparatus would register their presence, and rightly so.

Yet another instance is the observing of certain phenomenon in one instrument, whilst other means fail to record it. In several eclipses observers using a slit spectroscope have recorded the presence of bright hydrogen, magnesium, and iron lines in the spectrum of the corona, and yet the prismatic camera failed to show any of these lines. In the slit spectroscope any light falling on the slit will be observable as images of the slit, and in addition to the direct light from the corona and chromosphere, there is a certain amount of light derived from the same source, but diffused by particles in our atmosphere, which is capable of illuminating the slit sufficiently to be observable. Thus, the bright lines of hydrogen have been observed to extend over the dark disc of the moon.

The prismatic camera, however, fails to register such spurious radiations of hydrogen and calcium in the corona, as no images of the scattered reflections can be formed.

The recording of the flash spectrum will form an important item in the programme, both with slit and slitless spectroscopes. It is extremely doubtful, however, whether the spectroscope suitable for this work is also efficient for capturing the spectrum of the corona; in fact, the "flash" requires both a large image and great dispersion for its disintegration and comparison with the Fraunhofer spectrum, whilst the corona would be more favourably attacked with a small image and high dispersion, in order that the lines or rings may be intense, whilst the continuous spectrum is either resolved or so enfeebled that the lines are exhibited in better contrast.

The "shadow bands" are a subsidiary phenomenon, and on this account they have usually been neglected or treated in an unscientific manner; thus we read that their progress was at the rate "of a trotting horse," and observations have usually been confined to one plane. It seems important to gain more definite information about them, whether they are due to scintillatory effects of the atmosphere, in which case wind direction may be important; or, what is more doubtful, are they some diffraction effect? Whatever be the true explanation, it seems necessary to observe them on two planes at right angles to one another, whence the plane in which they lie, or its normal, may be ascertained, and its reference to the sun or the cusps may be determined. Observation should also be made to see if they persist during totality, and especially should they be looked for at any stations of high altitude to note the effect of diminished atmosphere.

If their movement be too great for accurate eye esti-

XUM

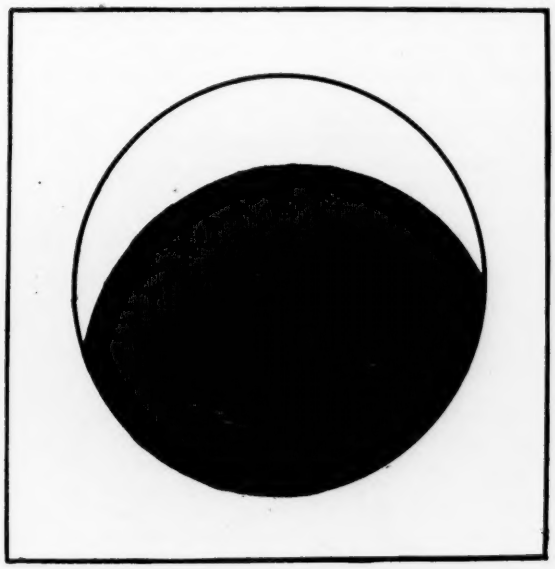
mation over a known length, observation might be made by intermittent vision, say by rotating sectors, and thus determine when they appear at rest.

Observers will be stationed at various points of vantage along the belt of totality, and arrangements have been made for the following British observers to occupy the places named :—

SPAIN.	
Mr. J. Evershed	Burgos.
Rev. A. L. Cortie, S.J.	Tortosa.
Prof. Callendar, Prof. Fowler, Mr. Shackleton	Oropesa.
MAJORCA.	
Mr. Crommelin	Palma.
ALGERIA.	
Sir Norman Lockyer, Dr. Lockyer, Mr. Butler	Philippeville.
Mr. Newall	Bona.
TUNIS.	
Sir William Christie (The Astronomer-Royal), Mr. Dyson, Mr. Davidson	Sfax.
EGYPT.	
Prof. Turner, Mr. Bellamy	

In addition to the above, American parties will observe from Canada, Spain, and Egypt, whilst three French astronomical parties have selected Burgos, Tortosa, and the Mediterranean coast, and two others intend to observe it from Sfax and Philippeville, Algeria.

It is to be hoped that the weather will be propitious, and that observers may obtain good results all along the line.



Eclipse, as visible in London.

In London the eclipse will be visible as a partial one, 8-10ths of the sun's diameter being obscured ; the diagram given above exhibits the appearance at maximum phase, which takes place at 1.5 p.m., on August 30.

With 73 per cent. of the light cut off, it should be possible to make observation of the remaining chromospheric arc to a greater depth than is usually done in full sunlight, and observers remaining at home would be doing useful work in measuring the depth visible, or in searching for the corona line at λ 5303.

It is too much to hope that the corona itself can be recorded, but it would be well worth trying to photograph the dark moon beyond the limb of the sun, for both Mercury and Venus have been visible as black discs, just before transit, signifying a background of sensible brightness compared with the aerial illumination.

Natural Gas in America.

ACCORDING to the annual report of the United States Geological Survey, the natural gas industry in the United States, so far from decreasing, has shown in the last reported year a considerable increase. According to the last report of the United States Geological Survey its value in 1903 increased from £6,000,000 to £7,000,000 (not dollars); and there was a remarkable increase of production in Pennsylvania and Ohio. West Virginia and Indiana were the other two States in which natural gas production was of any importance, and Indiana is the only one of them recording decreased production. The general average of the price paid by the consumer increased slightly, and was about 7½d. per 1,000 cubic feet at a pressure of a quarter of a pound to the square inch. The increase in the use and consumption of natural gas in the States is no doubt to be attributed to legislative restrictions with regard to boring; and to improved pumping machinery. The prodigal waste which characterised the early discovery of natural gas—when people used to use it almost as a plaything—has ceased, and new borings can be made only under State supervision. There seems no reason to suppose that any new areas of great extent will be found; the gas-bearing strata are now fairly well defined, and their possibilities ascertained.

It is not a little remarkable that side by side with the increased use and value of natural gas, the output of petroleum should also be on the increase. According to Mr. F. H. Oliphant, of the United States Geological Survey, the total production of crude petroleum in the United States in 1903 was 100,461,337 barrels, a gain of 11,694,421 barrels, or 13.17 per cent. over the production of 1902. The great increase was mainly due to the remarkable output in California, which is now larger than that of any other State. California produced 24.27 per cent., or nearly one-fourth of the entire production. Next to California the largest gain in production was in Indiana, which was 1,705,515 barrels, an amount that represents a gain of 22.80 per cent. over the State's production in 1902. Kansas showed a remarkable gain in production—600,465 barrels, or 181 per cent.; Kentucky and Louisiana showed gains of about 369,000 barrels each; Indian Territory gained 101,811 barrels, or 274.4 per cent.; and New York gained 43,248 barrels, or 3.86 per cent. On the other hand, there was a slight decrease of production, 128,086 barrels, or 0.708 per cent., in Texas; and Ohio, Pennsylvania, and West Virginia all showed decreased production, amounting to a total of 1,856,619 barrels, or 3.98 per cent., in 1903 as compared with 1902. The largest decrease in production in 1903 was in Pennsylvania, and amounted to 708,724 barrels. During the last six years there has been a very remarkable change in the percentage of the local production. The Appalachian and the Lima-Indiana fields, which for many years produced all but a very small percentage of the whole, produced in the year 1903 only 55.38 per cent. of the total, whereas in 1898 these fields produced 93.99 per cent. of the total. California and Texas have been the most important factors in bringing about the readjustment of the percentages of production.

XUM

"Ad Infinitum."

The Structure of the Atom.

By BERESFORD INGRAM, B.A. (CANTAB.), F.C.S.

PROF. J. J. THOMSON'S lecture at the Royal Institution on March 10 on "The Structure of an Atom" must have been bewildering to an extreme to all those who are not acquainted with the most recent developments of science.

To many of us an "atom" conveys but a very vague idea. We think of it as something smaller than one of those fine dust particles we see floating about in air when a beam of sun-light enters a room. We are told it has weight, but at the same time we are instructed that we have no means of weighing it. A reasonable conception of its size can be gained by imagining an ordinary drop of water to be magnified to the size of the earth, then the particles composing the drop would be the size of cricket balls.

Chemistry has taught us how these particles arrange and behave themselves one to another, but physics goes further than that, and proposes to show us of what and how these particles are made up.

Over ten years ago Prof. Thomson proved that one of these *atoms** of hydrogen is composed of one thousand smaller particles. All these particles or "corpuscles" have the same mass, and are similarly charged with negative electricity.

If this be so, then they must all repel one another. This fact compelled the physicist to consider all these particles being held together by a positive charge of electricity, an assumption which, to some extent, was warrantable by reason of the fact that positive electricity is always found associated with large masses of matter.

Thus the simplest form of matter that can be imagined is one of these negatively-charged corpuscles being surrounded by a sphere of positive electrification.

Before anything further can be known about the atom we must find out how these corpuscles arrange themselves when there is more than one in the atom.

This is, to some extent, experimentally demonstrated by taking some short thin rods of steel and magnetising them. They are then stuck through corks, and so arranged that when placed in water they will float perpendicularly with their north poles uppermost out of the water. In this way the magnets can move in one plane only, *i.e.*, that of the surface of the water; but it must be borne in mind that the corpuscles composing an atom are assumed to be free to move in any direction.

When two such magnets are placed in water they, of course, assume some position apart from one another; three form an equilateral triangle; four form a square, five form a circle with the magnets at equal distances from one another, six form a circle with one in the middle.

The following list shows how the magnets would arrange themselves when thrown indescriminately into the water, from which we conclude that such is their position or arrangement of equilibrium.

No. of magnets	5,	7,	8,	9,	11,	13,	19,	23,	30,	36..272
Outer ring ..	5,	6,	7,	8,	9,	10,	12,	13,	15,	16.. 40
Inner ring ..	0,	1,	1,	1,	2,	3,	7,	10,	15,	20..232

* An atom is defined as the smallest quantity of an element which can enter into combination with any other element.

The arrangement is found to be more stable, the greater the number of magnets within the inner ring.

Supposing an atom to contain twenty such particles, then from the above table we could find out how they arranged themselves. Look along the first line of numbers and select the one nearest to twenty; it is nineteen. This, as is observed, arranges itself twelve in the outer ring and seven in the inner; there is still one corpuscle over which would go *within* the inner ring and increase the stability of the atom. Similarly, an atom with 21 corpuscles would have twelve in the outer, seven in the inner, and two in the inmost, and would be even more stable than the atom with twenty corpuscles. Twenty-two corpuscles would make a more stable atom still. When, however, we get to twenty-three corpuscles a new arrangement takes place in which we get two rings only—thirteen in the outer and ten in the inner. As the number increases from twenty-three to thirty, we get a whole series of bodies with increasing stability (since the extra corpuscles are entering the area of the inner ring) until we come to thirty, when we suddenly get another arrangement.

But this is exactly what we get in the periodic classification of elements. Starting with lithium, and taking the elements in order, as their atomic weights increase, we find we go from elements of marked electro-positive nature to those of decided electro-negative, then suddenly it reverts to an electro-positive element and the gradation to the negative element starts all over again.

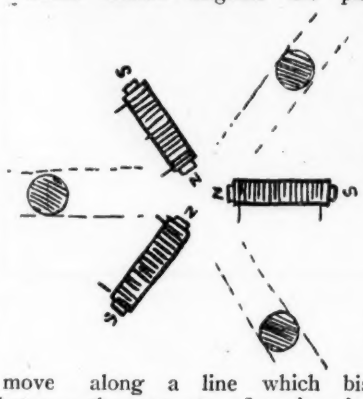
Thus sodium, which marks the sudden reversion from electro-negative to electro-positive elements, may be considered as containing the arrangement necessary to give lithium its electro-positive properties with another ring (arrangement) or rings, that have no odd corpuscles, added on to it. If, by any means, hereafter to be discovered, the atom of sodium could be robbed of its extra ring or rings, *as a whole*, we should expect the transmutation of sodium to lithium to have been effected.

So much, then, for the arrangement of the corpuscles forming the atom; now let us turn our attention to the behaviour of the atom itself.

Even a superficial knowledge of chemistry would be enough to force upon us the conviction that there exists some constant law controlling the movements of the atoms composing an element.

A study of the following experiment will show very clearly that the atom does not obey any of the existing laws which are known to control matter.

Three electro-magnets are placed as in figure, with their north poles pointing towards a centre. Between the angles so formed are placed three vessels of water which allow one magnet to float perpendicularly in each, north pole uppermost. The magnets are so arranged by guiding wire that they can only move along a line which bisects the angles between the magnets. Imagine, for the sake of illustration, that the electro-magnets in the centre form a



nitrogen atom, and that the magnets in the water are hydrogen atoms.

Now switch on the current and observe the floating magnets; they all approach the "nitrogen atom" up to a certain distance and no further. The movement is very decided at first, but slows down gradually up to the said point. Move the "nitrogen atom" round so that the movable magnets ("hydrogen atoms") are in a direct line with the electro-magnets and the movements of the former obey the ordinary laws of magnetic repulsion.

The experiment seems to point out that the condition essential to stability in chemical combination is that "*the attraction of one atom to another* (or others) *increases as the distance increases.*" It is thus the opposite to the law of inverse squares.

It would also seem to show that combination is only effected when the atoms have taken up a definite position one with another.

We may suppose an atom to have around it certain regions which are habitable by other atoms, and when the former are occupied by the latter a stable body results.

This would harmonise with our ideas of valency and make the suggestion reasonable, that an element may be polyvalent, since it is supposed to have so many "valency regions" which may or may not be occupied by other atoms.

A carbon atom is said to have four such valency regions. If, now, two carbon atoms are brought together in such a way that one valency region of one carbon atom comes into intimate contact or coincides with one valency region of the other carbon atom, then the region referred to is rendered uninhabitable; the two carbon atoms are held together by a force which obeys the law enunciated above, and we get a ready and adequate conception of the constitution of ethane C_2 H_6. Similarly when two "valency regions" of the carbon atoms coincide we get the constitution of ethylene C_2 H_4, and when three (since the regions must not be supposed to be in one plane), we get the constitution of acetylene C_2 H_2.

So little is known about the properties of electricity that it may be doubted whether the atoms are, indeed, electrified; but apart from the mathematical calculations based on that assumption, which confirm all the known facts, there are other sources from which evidence can be drawn, one of which is especially worthy of attention:—

> "Solutions of certain compounds are observed to rotate the plane of polarization."

If atoms are charged, the explanation of this phenomenon is simple and straightforward. If, however, the assumption is rejected, the explanation becomes complex and unsatisfactory.

For many years the scientific world has been satisfied with its conception of the atom as first taught by Democritus and afterwards strengthened by Dalton as a result of his quantitative experiments.

This conception successfully grappled any difficulty that could not be explained except by assuming that the atom was a small indivisible particle.

It is only comparatively recent research in physics that has demanded its sub-division, and although this does not effect its definition as far as the chemist is concerned, yet others may ask "Can this corpuscle be divided?" Shall we hear some physicist in later years expatiating on the structure of this corpuscle, or shall we be told that now we are as far as we can go, since the corpuscle is the smallest mass conceivable?

How Britain became an Island.

By EDWARD A. MARTIN, F.G.S.
Author of "A Bibliography of Gilbert White," &c.

THERE are few phenomena which appeal to the imagination so vividly, and bring to mind the solid geological fact that what is now land was not always dry land, and that where now rolls the open sea was not always covered by the waters of the ocean, than what is known to sea-faring men as the Dogger Bank.

As a geologist, one is frequently being asked whether it is a fact that this or that place in which the questioner happens to be interested for the time being was at one time beneath the sea. Those who have not grasped the great geological truth that the level of the land-surface has constantly changed in the past, and even now, in many parts of the world, is undergoing either subsidence or elevation, frequently express considerable surprise when they learn that the earth's crust is continually subject to vertical movements; and greater surprise still is shown when it flashes upon them as a geological fact, that Great Britain was not always an island; and that since the time that our country was inhabited by mankind, it had a continental existence, being, in fact, but a portion of a north-western extension of the continent of Europe.

Although, at a later period in its history, England formed a peninsula which was connected with Europe only by a narrow neck where now are the Straits of Dover, yet, at still earlier time, we have ample evidence to show that Ireland was joined to Great Britain, and the latter to Denmark and Scandinavia. This could, of course, only be so when all those now isolated countries formed portions of a vast plateau, when the seaboard was at some considerable distance from the present coast, and the whole was at a much greater elevation above the sea than now.

It is a well-known fact to mariners that when they pass out of the English Channel into the Atlantic, in a comparatively short distance they pass from shallow depths to those which are ten times as great. The same experience is gained in going west from any point on our west coasts, and also in a northerly direction from the north of Scotland. But it is very different on our eastern coasts. With exception of a narrow strip off the Norway coast, which would appear to have been at one time the bed of a rapidly-flowing river with considerable power of excavation, the whole of the North Sea is shallow, as compared with the depths found in other seas of the same magnitude.

If we look at one of the hydrographical maps of the Admiralty, we shall see that the hundred-fathom line is found some little distance beyond the north of Scotland, and that thence it proceeds in an easterly direction almost to the coast of Norway, leaving the North Sea to the south of it, and all of that sea enclosed within that line is under 100 fathoms, or six hundred feet deep. This is a very shallow depth for a sea of the size of the North Sea.

Now follow the same 100-fathom line around our west coasts, and we find that it proceeds some considerable distance beyond the outermost of the Hebrides,

XUM

when it turns south, so as to include within it the whole of Ireland. Then, following the same line still further south, it is found off the entrance to the English Channel, when, crossing the Bay of Biscay, it reaches very near to the coast of Spain. It is when we pass beyond the limits of this line that we find a comparatively rapid descent into oceanic depths. In fact, it roughly represents the coast-line of the plateau-like extension on which the British Isles stand, and is in itself evidence of a great probability that up to that limit what is now the bed of the ocean was once dry land.

The changes which have since taken place form a history of extreme interest, but it must be borne in mind that great though the changes were, they were extremely gradual in their accomplishment. After the great plunge which had visited these islands in the middle of what is known as the Ice Age, the area of the North Sea had become a mass of ice, and this, travelling westwards from the heights of Scandinavia, had turned aside the numerous smaller masses of moving ice which had been given birth to by the Scottish mountains, and the heights of the Pennines andWales. The result was that such parts of our higher lands which were above the sea-level were submerged beneath the ice-sheet, and the whole country must have presented an appearance not unlike Greenland of the present day. Possibly here and there the highest points of our mountains projected through snow and ice, forming prominences, or "nunataks," similar to those seen by Nansen when crossing Greenland. But at the height of the glacial period, probably even these were covered, and right away from an elevated Scandinavia the ice slowly moved westwards, and, overflowing our islands, passed on to break up into icebergs in the ocean to the west and south-west.

The submergence of the islands lasted, humanly speaking, for a long period of years. From a geological point of view it lasted long enough to allow of the formation upon the glacier-formed boulder-clay of certain shell-bearing gravels; but as these are now at heights of 1,800 or 2,000 feet above the sea-level, there has apparently been, since these inter-glacial days, an uprise of the land to that extent. Such shell-beds are found near Macclesfield, at Moel Tryfaen, and on the shores of the Clyde.

We are here therefore presented with the fact that an enormous elevation of the land took place, and that this happened after both sea, and what little land there was left, had been submerged beneath the great ice-sheet.

Apparently by this time a decline had set in so far as the severity of the climate was concerned. The glaciers in our own mountain regions commenced to reassert themselves, this being only possible when the Scandinavian intruder commenced to retire. There was no longer a sea of ice. Switzerland or the Himalayas would give us a truer picture of our country at this time, when the glacial conditions were on the wane.

Many of the boulders which are now scattered about far from their place of birth may have taken their journeys at this time; or those that had journeyed during the period of the first formed boulder-clay may now again have been taken up by the recurring glaciers, and sentenced to retransportation. The great lumps of shap granite that one sees at Robin Hood's Bay and at Heyburn Wyke, or in the churchyard at Grosmont, may have been brought to rest now, far from the home of their birth in the Westmoreland Hills.

The re-elevation of the land must have had marked effect upon the coast-line. Probably the movement went on until the coast was thrown outward to the 100-fathom line, and our country was but a central portion of the great plateau then exposed. There was no English Channel left, and hence the Channel Islands and our own Isle of Wight were continentally connected. The Bristol Channel was non-existent. There was no St. George's Channel between Ireland and Great Britain. The Hebrides, the Shetlands, and Orkneys were all part of the land-mass, and the North Sea was non-existent.

In the centre of the North Sea there was at this time an area of about 300 square miles, which was considerably higher than the surrounding North Sea Plain. This was situated some 100 miles off our present Northumbrian and Yorkshire coasts, and what is now left of it beneath the sea is the famous Dogger Bank.

On the whole, this plain must have been a wide, dull, and uninteresting flat extent of land, but although it had but few heights, it was eminently suitable to be the habitat of herds of wild animals. For, in the course of time, the ice passed away completely, forests grew upon the land, with pasturage suitable for the vegetarian livers who swarmed upon it. This was at the time when the British elephant was in his prime. Herds of bisons roamed over it. Crowds of reindeer and Irish elks added picturesqueness to the landscape. And in the waters and rivers the woolly rhinoceros and the hippopotamus disported themselves.

But what of the rivers which watered the land? Where did the rivers of Germany turn to in order to find an exit into the sea? Where went our Thames, our Severn, and our southward-flowing rivers?

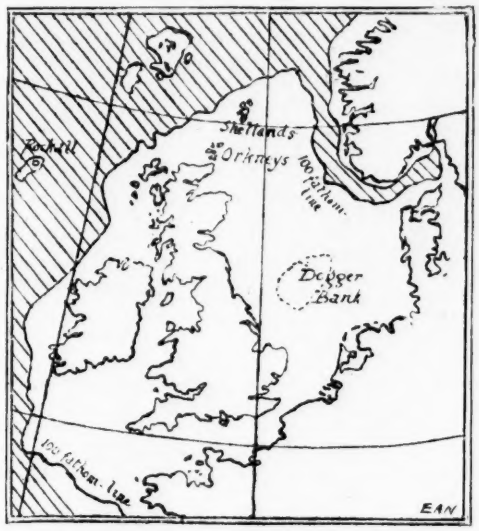
There being no English Channel, a river which rose in the submerged Wealden area between Hastings and the French coast no doubt passed westward to the ocean, receiving on its way as tributaries the rivers on the French and English coasts. The Severn and a river from the Irish Sea may have joined to form another such river, and this may have also joined the Channel stream. Our Neolithic progenitors, in coming to us from the Continent, would have had to cross this river, but with the many monuments which they have left of their civilisation this would not probably have caused them any difficulty. For the greater part their journey would have been on dry land.

The German rivers no doubt excavated their own valleys across the plain and emptied themselves into the northern ocean.

But what became of the great Rhine? As it now emerges into the sea, it seems to point to the west. But it could scarcely have continued in that direction, for the parallel ranges of chalk downs were then existent between the English and French coasts, and these would be sufficient to turn the river northwards. There is little doubt, in fact, that it travelled north, some little distance off our British coasts, and that the Thames and all our eastward-flowing rivers formed tributaries on its left bank. Some of the most important fishing grounds now seem to be in the valleys scooped out by this long-ago greatly-extended Rhine.

This condition of affairs did not last long in geological time. The sea had for some time been creeping up the English Channel and forming raised beaches at Freshwater, Brighton, and elsewhere, and, when Scotland and Northern England began to sink, together with the North Sea Plain, the sea began to encroach

upon its former dominions. The animals retreated farther and farther south, until many of them took refuge upon the high land of the Dogger Bank. This, in the course of time, became an island, the sea soon enclosing it on every side. In the trawling operations which are constantly going on in the region of the Dogger, many bones and teeth of the mammoth and other animals now extinct in those regions are constantly being brought up. In fact, scarcely a trawl is brought to the surface that does not contain some of these remains. Now why should they be found there in such abundance? Probably the various currents which were brought into play as the surrounding parts came to the surface may have been responsible for banking up hereon many of the bones, &c., collected from the area which was sinking into the sea. But there seems also good reason to believe that the Dogger



Island formed a veritable place of refuge, where were congregated during the last years of its existence the numerous animals who had been driven south, who had here been stranded involuntarily while the advancing sea cut off their retreat. Between the time of its having become an island and its own final disappearance beneath the ocean, not many thousands of years may have elapsed. There would be no time for the evolution of fresh species. Those that were first here isolated were of the same kind as those who were finally starved out, or overwhelmed in the advancing waters. There in the end they succumbed, and their remains are now brought up in the North Sea trawling nets.

We can pursue the evolution of the British Isles a step further. Britain had by this time received its complement of Neolithic savages, whilst Palæolithic man, who had seen the advent and disappearance of the great ice age, had also disappeared before the march of the more civilised Neolithic man. Owing to the absence of true glacial formations in England south of the Thames, it is considered that these parts at no time were the nursery grounds of glaciers, and that they did not participate in that great subsidence which visited all those parts which were subjected to the enormous weight of the great ice-sheet. The North Downs were all the while continuous from the Forelands and from Folkestone to the Continent, as well as the South Downs from Beachy Head, and the intermediate Wealden Heights from the neighbourhood of Hastings.

When the sinking took place in the bed of the English Channel, which allowed of the approach of the sea, the action of the waves, aided to an important extent by tide action, soon widened the Channel by eating away the soft tertiary strata which probably covered the chalk. Then attacking the chalk it formed cliffs of this rock, and the work proceeded until the sea had encroached to a point east of Brighton on the British coast, and a corresponding position on the French coast. Here was a pause, to which are to be attributed the raised beaches, which rest upon ledges in the chalk, with the old chalk cliffs behind them.

But soon the pause came to an end. The sea again advanced, and cut through the beaches it had formed at the eastern end of the English gulf. Thus was lost the connecting sea-margin between England and France. Probably this eastern shore was pierced at more than one place by short rivers, which were then draining the Wealden saddle-back ridge which formed the backbone of the Anglo-French isthmus. Others may have flowed in the opposite direction and have been at one time part of the great Rhine system. Similar rivers piercing our present chalk downs and taking their rise in the Weald are seen in the Sussex Ouse, the Arun, and Adur; in the Mole, the Wey, and the Darent; but in these days they were powerful rivers, and flowed from a greater height than now.

The advancing sea would creep up the beds of these imaginary rivers, widening their valleys as it advanced. Soon it would reach the low parts of the Weald clay between the two parallel ridges of chalk downs, and the English Gulf and the North Sea would join hands by the connection provided by the river valleys. Thus the chalk hills would be attacked in the rear, and in the course of a short geological period the chalk isthmus would be gradually planed down, and the incipient Strait of Dover become an accomplished fact. Once the passage had been made for the tides, the breach would quickly widen, and the isolation of Britain thus became assured.

The position gained has been maintained. Britain an island had been the end to which geological agencies had been moving for many thousands of years. Now the end was gained. Britain an island had become an accomplished fact, and in spite of numerous subsequent minor movements she has retained that position which Nature gave her—an island set in the silver sea.

Absorption of Mercury Vapour by Aluminium.

M. TARUGI has recently been investigating the power which aluminium has for absorbing mercury vapour. This is manifest even when the vapour is largely diluted with air, and at the temperature of the surrounding atmosphere. This property constitutes a very delicate method of analysing the presence of mercury, and furnishes a means of prevention against poisoning by its vapours. A respirator has been constructed in which the air, before entering the lungs, has to pass through a mass of finely-pulverised aluminium, and in this way all traces of mercury are absorbed so completely that breathing can be carried on even in the dense vapours produced by the burning of chloride of mercury.

Monoclea Forsteri.

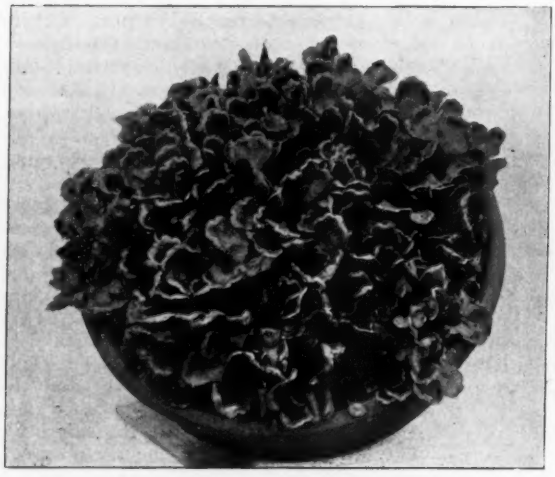
By LEO FARMAR.

THIS little plant is a glorified relative of the Common Liverwort, which is so frequently seen growing on the soil of pots in conservatories.

The genus Monoclea is an interesting exemplification of the evolution of types, forming as it does a connecting link between the liverworts proper (Marchantiaceæ) and the scale mosses (Jungermanniaceæ).

It has always been a matter of contention as to which section it belongs, some botanists placing it in the one while others placed it in the other group.

Professor Duncan S. Johnson, of the Hopkins University, U.S.A., has recently investigated and been able to throw additional light on the subject,* showing beyond doubt that the hepatic plant in question belongs to the order of Marchantiaceæ.



Monoclea Forsteri, Hooker.

Among other important characters, Professor Johnson has discovered that some of the rhizoids, or one-celled roots, have minute tubercles on the inner surface of their cell wall, just as in the Liverworts proper. These tuberculate rhizoids have been overlooked by earlier observers, probably because of their comparative rarity.

The conclusions arrived at are: "That the thallus (the plate-like vegetative portion) of Monoclea is like that of the Marchantiaceæ in gross structure, in the mode of growth and branching, in the type of initial cell, and . . . in the possession of tuberculate rhizoids, as well as thin-walled ones, in which latter character Monoclea differs from all described Jungermanniaceæ."

He further adds that "the facts of vegetative structure referred to strongly indicate a relationship with the Marchantiaceæ and the structure and development of the reproductive organs seem to me to confirm this beyond reasonable doubt."

* "The Development and Relationship of Monoclea." Duncan S. Johnson. *Botanical Gazette*, September, 1904.

Monoclea occurs in Jamaica chiefly on wet rocks and banks in the mountain forests. It may be seen growing most luxuriantly in some of the small depressions near New Haven Gap in the Blue Mountains. It is distributed also in New Zealand and Patagonia, and was first brought home by a naturalist who accompanied Captain Cook on his famous voyage.

The annexed photograph is of a specimen cultivated in the Physic Garden at Chelsea. It is a beautiful object, its delicate dark-green crisp and crested foliage makes it worthy of a place among the choicest of tropical plants.

The Unfolding of the Wings of Insects Emerging from the Pupæ State.

By THE REV. ARTHUR EAST.

NOT the least astonishing detail of the marvellous change from a mummified chrysalis, or an unsightly nymph into a winged insect of more or less surpassing beauty, is the manner in which the wings unfold. Looking at the small size of the wing cases in the chrysalis, and contrasting these with the comparatively enormous wings of the perfect insect, it seems impossible that these wings should have been folded into so small a space.

Fig. 1.—Crumpled appearance of the wings upon emergence from the nymph skin.

The process of unfolding is most easily studied in the case of clear-winged insects, as when the wings are clothed with scales the effects, to which the present article is intended to draw attention, are marked. Probably one of the best examples is one of the larger dragon-flies, as the wings are excessively large, and the body, being also bare of scales, shows clearly the part which it plays in the unfolding of the wings.

Fig. 1 shows the appearance of the wings of the great green dragon-fly Æschna Cyanea, when emerging from the nymph skin—little more than a lump of damp, crumpled wing material, greyish in colour, and quite opaque; yet in three hours these insignificant excrescences have to expand to wings considerably longer than the body, and to become perfectly flat and transparent.

How is the unfolding done? It might be supposed, from the fact that such a large number of the heavier insects climb up some support and let the wings hang down as they expand, that the weight of the wings alone would account for the unfolding; this, no doubt, is a considerable help, but it is not sufficient to account for the perfect flatness ultimately obtained, and, moreover, it takes no account of those winged insects which do not hang themselves up, the common gnat, for instance.

Fig. 2.—Insect hanging erect, the wings beginning to unfold.

Fig. 3.—The wings unfolding, the abdomen strongly bowed and much distended.

Fig. 4.—The wings unfolding, the abdomen strongly bowed and much distended.

We may reject, I think, the notion that air is injected, as that would probably cause a certain "puffiness" in the wing, of which there is no sign. I hope to show that the expansion of the wing is effected, in one instance at least, by the injection of fluid, and thus it is a spontaneous action, and entirely under the control of the insect itself.

Now, in the case of the dragon-fly illustrated, the insect, on emerging, hangs head downwards for some little time, for twenty minutes or more; during that time there is not the smallest tendency of the wings to unfold, but directly the second stage of emergence is reached and the insect hangs *right way up*, the wings begin to unfold *at once;* careful observation will show, moreover, that the unfolding is not continuous nor regular as if the creases were simply falling out, but is by fits and starts, and that these irregular movements correspond exactly with great muscular efforts, the segments of the abdomen are contracted, and the impression given is that of someone taking a deep breath and exerting great force. Occasionally there are spasmodic jerks and quiverings, as if to shake loose the folds of the wings. All this time the abdomen is strongly bowed to the exact curve to be occupied by the wing, no doubt to avoid injury to the excessively tender fabric of the wing. It is scarcely possible to doubt that the wings are being forced out of their folds by the muscular energy of the insect.

And that it is fluid which is injected seems to be shown by the fact that if the wing is injured at this stage large drops of emerald green fluid are extruded. An instance of this came under my notice; this particular insect was injured by a grass stem, and the wing did not recover, it remained crumpled and was a complete failure.

Fig. 5.—The abdomen straight, wings nearly dry.

An interesting question remains as to what becomes of this fluid, for at a later stage the wings are perfectly dry. Some of it probably escapes through the pores of the wing, but I am inclined to think that the greater part is withdrawn into the abdomen by an action the reverse of that by which it was injected.

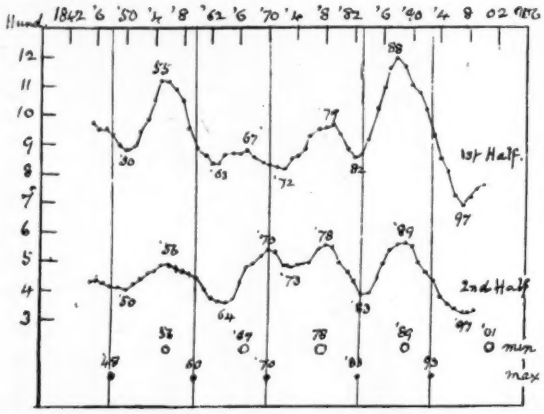
For hours after the wings are perfectly flat and dry the abdomen is greatly distended throughout its whole length, and at intervals during the first day after emergence, fluid is ejected, a drop or two at a time, from the *rectum*. This fluid is perfectly colourless, the green colouring matter being retained in the body of the insect (in this case of Æschna Cyanea or *green* insect). And not for several days does the abdomen become dry and quill-like as when we see the insect on the wing.

Forecasting Seasons.

TO THE EDITORS OF "KNOWLEDGE."

SIRS,—While there are many weather prophets, we seem to have at present little or no sound knowledge as to the character of future seasons, though the cyclical nature of much of our weather, on which fresh light is being thrown, gives reason to hope that this important art of long-range forecasting will one day be achieved, in some measure.

I have lately met with a case in which, I think, one could feel something like certainty regarding a forecast of distant weather; and a forecast sufficiently definite to be useful. The subject is that of the number of frost days at Greenwich in the latter half of 1904 (the average in that half being about 18).



For such inquiries I have been making use of *twice-smoothed curves*. Thus in the present case, the series of numbers of frost days in the latter half, from 1841, is first smoothed in sums of five (grouping 1841-45, '42-'46, and so on). Then these sums are smoothed in the same way. The sum in each case is put opposite the middle member of the group.

The series thus obtained yields the lower curve of the diagram. The upper curve is got in the same way from the numbers of frost days in the *earlier* half of the year (average 37). Above are indicated the years of maximum and minimum sunspots (without regard to numerical relations), the influence of which, I believe, comes out in these curves; but without entering into this question, or considering how this double smoothing affects the truth of Nature, I would merely call attention to the continuous up and down course of the curves—the rise for several years from the lowest points, and fall for several years from the highest.

The lower curve, ending in 1899, is derived from the actual series ending in 1903. Now, in prospect of the latter half of 1904, we might ask, What will the curve do next, go up or down? Few, probably, would hesitate to say, go up. Then how much will it go up? Here it often seems difficult to form a right conjecture. But in the present case it so happens that a rise of only 1, that is, an addition of one day to the figure for 1899, means that the actual number of frost days for 1904 would be in excess of the average (over 18). I will give the figures from 1890 to make this clear:—

	1890	1891	1892	1893	1894	1895	1896	1897
(*a*)	33	14	22	14	11	14	18	8
(*b*)			94	75	79	65	61	68
(*c*)					374	348	330	314
	1898	1899	1900	1901	1902	1903	1904	
(*a*)	10	18	3	24	10	12	(20)	
(*b*)	57	63	65	67	(69)			
(*c*)	314	320	(321)					

(*a*) Actual numbers. (*b*) First smoothing. (*c*) Second smoothing.

The figures in brackets are those for an addition of 1 to the curve-value of 1899, giving the value 20 for (*a*) in 1904; 2 above average.

The actual number proves to be 23; 5 above average.

One could thus safely predict a cold last quarter (frost days over average), and might even estimate the amount of excess approximately.

Doubtless other cases equally clear may be met with.

I am, yours, &c.,

ALEX. B. MACDOWALL.

9, Saltwood Gardens, Hythe.

Wireless Telegraphy.

THOSE particulars that have been made public of the operations of wireless telegraphy in the Russo-Japanese war have amply served to endorse the soundness of the official view that all the wireless telegraphic installations of a country should be licensed and known, so that in case of war they could be immediately brought under Governmental supervision and control. We are in a position to say that the Government Wireless Telegraphy Bill, which was at first vigorously condemned by more than one electrical engineer as likely to hamper and stifle enterprise, has been found in practice to do nothing of the kind, and is now acclaimed by some who were at first its opponents. The Act is being administered in a broad-minded spirit, and it has been recognised that it operates for the convenience of investigators. "Before the Act," Professor J. A. Fleming has recently said, "we were in the position of a number of people at a public meeting who might by all speaking at once prevent anyone from being heard. The Act regulates and distinguishes our utterances," which is another way of saying that as yet wireless telegraphy has not yet reached the stage when it is secure against violent "interference" from conflicting stations. The same is true in a less degree of ordinary telegraphy along wires, which might be upset by anyone rich enough or malicious enough to set the requisite quantity of electric energy in motion. But it is the fact that wireless messages, if regulated and controlled, can be sent and received without interfering with other wireless stations with which they are not concerned. The next step in wireless telegraphy will be to ascertain the point of origin from which a wireless wave is sent. That can be done to a limited extent now, but it will become more easily accomplished when the measurements of electric waves and the measurements of the sources of energy in, and produced by, wireless telegraphic instruments can be much more accurately measured. The present stage of wireless telegraphy resembles that of cable telegraphy before electricians like Lord Kelvin and Mr. Latimer Clark had shown that accuracy and distance could only be attained by instruments of measured refinement, and that the first step to this *desideratum* was refined measurement.

Star Maps.

IN our next issue (May) we propose to commence the series of new star maps. These will be on the system used in Proctor's Atlas, comprising in all twelve maps. The stars will be in white on a dark blue ground so as to stand out clearly, over which will be printed the names of the constellations, letters (and some names) of stars, and R.A. and Declination.

Stellar Brightness and Density.

By J. E. GORE, F.R.A.S.

THE absolute brightness of a star, or its so-called "magnitude," depends on three factors—(1), its distance from the earth; (2), its diameter; and (3), its intrinsic brilliancy, or the actual luminosity of its surface per unit of area. The first of these factors—the distance from the earth—has, in a few cases, been determined with considerable approach to accuracy, either by micrometrical observations of comparison stars, or from spectroscopical observations of binary stars. The second factor—the actual diameter of the star—is more difficult to determine, and its measurement has not been satisfactorily accomplished, except in some variables of the Algol type. An approximation to its probable value may, however, be arrived at from other considerations. The third factor—the luminosity of the star's surface—may be inferred—to some extent at least—from the character of the star's spectrum. This luminosity of surface, or intrinsic brightness, as it is also called, probably depends on the mass and density of the star. Two stars may have the same mass, but one may have a large diameter and small density, and the other a smaller diameter and greater density. The difference is probably a function of temperature. And then the question arises, which of the two stars will be apparently the brighter? We know that heat causes a mass of gas to expand, and the greater the heat the greater the expansion. And with a given mass, the greater the expansion the smaller the density will be. This is evident. Hence a star with a high temperature will have a large volume and small density. And it seems highly probable that the higher the temperature the greater will be the luminosity of its surface. From this it would follow that a star with a high temperature would have a large volume and light-giving surface, and also a greater luminosity of surface, and both causes would thus combine to increase its apparent brilliancy. This would not, however, apply to the nebulæ, but only to bodies, like the stars, which have consolidated to a certain extent.

It is now usually admitted that stars with the Orion type of spectrum (B, Pickering), such as Bellatrix (γ Orionis), δ, ϵ, and ζ Orionis,' are—with the possible exception of the "Wolf-Rayet," or bright line, stars—the most luminous among the brighter stars. Next to these come stars with the Sirian type of spectrum (A, Pickering), followed probably in decreasing order of surface luminosity by stars of the second (or solar) type, and then by the third and, perhaps, the fourth type stars. The "Algol variable" U Ophiuchi has a spectrum of the Orion type, and some of the other "Algols," such as Algol itself, λ Tauri, and V Puppis, show a spectrum intermediate between the B and A type. These will be considered further on.

The probably great luminosity of stars with the Orion type of spectrum is shown by the fact that Sir David Gill finds that the parallax of Rigel is almost certainly not more than the hundredth of a second of arc, and yet it is one of the brightest stars in the heavens; seventh in order of brightness,' according to the Harvard photometric measures. At the vast distance indicated by this minute parallax our sun would be reduced to a star of about the tenth magnitude, and would, therefore, be invisible even with a binocular field glass. Rigel is, therefore, about 7,800 times brighter than the sun would be if removed to the same distance. It has a small companion of the eighth magnitude, but as the pair have not yet been proved to be a binary (although the companion itself, which is double, probably is), we cannot determine its mass. But it is evident that it must be a body of enormous size and great luminosity of surface to shine as brightly as it does at such a vast distance from the earth—over 300 years' journey for light. Comparing it with Sirius, whose mass and parallax have been well determined, I find that the mass of Rigel is probably about 20,000 times the sun's mass.

The great brilliancy of stars with the Sirian type of spectrum is shown by Sirius itself, the distance of which is now well determined. From its apparent brightness and parallax I find that Sirius is about 31.6 times brighter than the sun would be at the same distance. From the orbit of its satellite Dr. See finds the mass of the bright star to be 2.36 times the sun's mass, and from this it follows that its real brightness is about 18 times greater than that of the sun in proportion to its mass. Its spectrum shows that it is probably at a higher temperature than our sun. Its volume is, therefore, probably larger, and, as Dr. See says, there "is some reason to suppose that Sirius is very much expanded, more nearly resembling a nebula than the sun." But here the question suggests itself, Is its greater brilliancy due to its larger volume, and, therefore, smaller density, or to its greater surface luminosity, or to both causes combined? As it is 31.6 times brighter than the sun, a diameter equal to the square root of 31.6, or 5.62 times the sun's diameter, would give the necessary brightness, *if* the surface luminosity of Sirius and the sun were the same. Assuming this for a moment, I find that with a diameter of 5.62 times the sun's diameter—or about five millions of miles—its volume would be 177 times the sun's volume, and its density only 0.019 (water = 1). This seems improbable, judging from the known case of Algol, which has a much higher density than this. We may, therefore, conclude, I think, that the great brilliancy of Sirius is probably due to both causes combined—namely, a somewhat larger volume and a greater luminosity of surface than the sun, both probably due to its higher temperature. If we assume its density to be the same as that of Algol, say 0.34, we have the diameter of Sirius about 1,860,000 miles, and its luminosity about seven times that of the sun.

The well-known double star, Castor (*a* Geminorum), has a spectrum of the same type as Sirius. The orbit is rather uncertain, but Dr. Dobeeck has recently found a period of 346.82 years, with a semi-axis major of 5″.756. A doubtful parallax of 0″.198 was found by Johnson. From these data the mass of the system would be only 0.2042 that of the sun. In 1894 the fainter component of the pair was found by Bélopolsky to be a spectroscopic binary with a period of about 2.98 days, and an orbital velocity of 20.7 miles a second, the companion being relatively dark. If we assume that the components of the spectroscopic pair are equal in mass I find that its mass would be 0.0911 of the sun's mass. Now as the brighter star of the *visual* binary is one magnitude brighter than the companion, its mass would be—if of the same surface luminosity—four times that of the other, or 0.3644. Hence the total mass of the system would be 0.0911 + 0.3644, or 0.4555 of the sun's mass. We may, therefore, conclude from the spectroscopic observations that the mass of the system is comparatively small. Assuming the masses found above, namely 0.0911 and 0.3644, the areas of their surfaces would be 0.2024 and

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0.5102, or a total surface of 0.7126. Now the mass of Sirius being 2.36, its relative surface would be—if of the same density as Castor—1.7726. Hence the surface of Sirius would be 2.487 times that of the combined surfaces of Castor's lucid components. But Sirius is 3.16 magnitudes (1.58+1.58) brighter than Castor. From these data I find that the parallax of Castor would be about 0″.136, which does not differ widely from the result found by Johnson. The brighter component of this interesting pair has recently been found at the Lick Observatory to be also a spectroscopic binary, but the period has not yet been determined. The fact that *both* components are spectroscopic binaries makes Castor one of the most remarkable objects in the heavens.

For δ Equulei, a binary star with the very short period of 5.7 years, Hussey finds from spectroscopic measures a parallax of 0″.071, and a combined mass of 1.89 times the sun's mass. He says, "The components of the pair are slightly unequal in brightness, and, perhaps, also in mass. One may be as massive as the sun, but it cannot much exceed it."* The parallax found by Hussey would, I find, reduce the sun to a star of 5.81 magnitude, and as the photometric magnitude of δ Equulei is 4.61, we have the star 1.20 magnitude, or three times brighter than the sun. Assuming that the masses of the components are 1.00 and 0.89 (as suggested by Hussey), I find that if the surface luminosity of each were equal to that of the sun, the combined light of the two components would be 1.9247, or nearly twice the sun's light. The star's spectrum is of the type F, probably indicating a somewhat brighter sun than ours. The difference in the results found above is, therefore, not inconsistent with the parallax found by Hussey. A comparison with Procyon is also confirmatory of Hussey's result.

Let us now consider the case of the bright star Procyon, which has a spectrum F 5 G, or intermediate between that of δ Equulei and the sun. The parallax is about 0″.325, and the mass of the system is, therefore, from Dr. See's orbit of the satellite, 3.627 times the sun's mass, that of the bright star being about three times the mass of the sun. At the distance indicated by the parallax the sun would, I find, be reduced to a star of 2.51 magnitude, and as the magnitude of Procyon is 0.48, we have the star 2.03 magnitude, or 6.487 times brighter than the sun. As, however, the mass of Procyon is three times the sun's mass, the star should be—if of the same density and surface luminosity, 2.08 times brighter than the sun. Hence it follows that Procyon is really $\frac{6.487}{2.08}$ or 3.1 times brighter than our sun in proportion to its mass. This may be due either to a larger size, and, therefore, less density than the sun, or to a greater luminosity of surface per unit of area. Probably both causes combine to produce the increased brilliancy, and the result seems to agree well with the star's spectrum, which probably indicates a slightly more luminous sun than ours.

The binary star 70 Ophiuchi has a spectrum intermediate between the second and third types (K, Pickering), probably indicating a rather fainter body than our sun. An orbit computed by Dr. See, combined with a parallax of 0″.16 found by Schur, gives a combined mass of 2.94 times the sun's mass. This parallax would reduce the sun to a star of about 4.05 magnitude, and as the photometric magnitude of 70 Ophiuchi is 4.07, the star is about equal to the sun in brightness. But as the star's mass is 2.94 times the sun's mass, the star should be, if exactly comparable with the sun, about twice as bright. Hence it would follow that the surface luminosity of the star is less than that of the sun—about one-half, and the spectrum indicates that this is probably the case.

Let us now consider the case of the "Algol variables." For Algol itself, Vogel found from spectroscopic observations the diameter of the bright star to be 1,074,000 miles, with a mass of 4-9ths of the sun's mass, and for the "dark" companion a diameter of 840,600 miles and a mass of 2-9ths of the solar mass. This result was obtained on the assumption that both components are of equal density—about one-third that of water. But that a dark body of such large size should have the same density as a bright body, like Algol itself, seems highly improbable. The density of the planet Jupiter—which has some inherent heat of its own—is about 1.30, and that of Saturn about 0.68. We should, therefore, expect that a large body, like the companion of Algol, would have a considerable amount of inherent light, or surface luminosity. Let us see what brightness it *could* have without sensibly affecting the observed light variation of Algol. That is, what is the maximum brightness which the companion might have without producing a secondary minimum of light when hidden behind the disc of the bright star? Chandler finds for Algol a parallax of 0″.07. The sun placed at the distance indicated by this small parallax would be reduced to the light of a star of 5.84 magnitude, and the photometric magnitude of Algol being 2.31, it would be 3.53 magnitude, or nearly 26 times brighter than the sun. Let us assume that the companion has this magnitude of 5.84—which it might have without the spectroscope showing it. Then when in the course of its orbital revolution round Algol it is hidden behind the bright star, the normal light of Algol would be reduced by its 27th part. This means that the light of Algol would be diminished by about 0.04 magnitude, or from 2.31 to 2.35, a difference which would not be perceptible to the naked eye, and could hardly be detected with certainty by even the most delicate photometer. The spectrum of Algol is, according to Pickering, B 8 A, that of Sirius being A. Comparing the two stars, and assuming the surface luminosity to be the same, I find a parallax of 0″.11 for Algol. This would reduce the sun to a star of 4.84 magnitude, and if we suppose the companion to have this brightness,* then Algol would be about 10 times brighter than its companion, and when the latter is hidden behind the brighter star, the light of Algol would be reduced from about 2.31 to 2.41, and even this difference could hardly be determined with certainty. It would seem probable, therefore, that the companion of Algol has some inherent light of its own, and is not quite a "dark body." Assuming a parallax of 0″.07, I find that the surface luminosity of Algol itself would be 17 times that of the sun.

In the Algol system the components are separated by a distance of over two millions of miles (between their surfaces), but in some of the "Algol variables" the components revolve in contact, or nearly so. Some have both components bright. Examples of this type of variation are β Lyræ, U Pegasi, V Puppis, X Carinæ, and RR Centauri. The characteristics of the light fluctuations are, according to Dr. A. W.

Astrophysical Journal June, 1903.

* It has been recently found that a difference in brightness of two magnitudes between the components of a spectroscopic binary is sufficient to obliterate the spectrum of the fainter component.

Roberts*, as follows: (1) "continuous variation, indicating that the component stars are in contact," and (2) two maxima and two minima, showing that the components are both bright bodies. The variation of β Lyræ is well known. It is not usually considered as an Algol variable, but it now seems probable that it should be included in that class. Myers finds that β Lyræ probably consists of two ellipsoidal components revolving nearly in contact, the mass of the larger component being 21 times the mass of the sun, and that of the smaller $9\frac{1}{2}$ times the sun's mass. He thinks that the mean density of the system "is comparable with atmospheric density"—that is, that they are "in a nebulous condition." If this conclusion is correct their diameters must be enormous. Taking the density of atmospheric air as 814 times less than that of water, I find that the larger component would have a diameter of about 25 millions of miles, and the smaller about 19 millions. The parallax of β Lyræ has not been ascertained, but supposing it to be about one-hundredth of a second, the sun would be reduced to a star of about the 10th magnitude. The maximum brightness of the star is about 3.5 magnitude. It would, therefore, be—with the assumed parallax—$6\frac{1}{2}$ magnitudes, or about 400 times brighter than the sun. From the diameters found above, the combined surfaces of the two components would be 1,332 times the sun's surface. Hence their surface luminosity would be less than one-third of that of the sun. This would agree with Homer Lane's law, by which a gaseous body gains in heat as it consolidates, and β Lyræ is probably in a very early stage of stellar evolution. If the parallax is larger than assumed above, the surface luminosity would be still less.

Another remarkable star is the Southern Algol variable, V Puppis (Lacaille 3105). Both components are bright. The spectrum of the brighter component is, according to Pickering, of the "Orion type," B 1 A, and that of the fainter B 3 A. The period of light variation is 1.454 day. The spectroscopic measures show that the relative velocity is about 380 miles a second. The combined mass of the system is, therefore, about 70 times the sun's mass. As the star is variable in light, the plane of the orbit must necessarily pass through the earth, and the accuracy of this result for the mass is, therefore, certain. This great mass, and the star's magnitude—about 4.50, shows that it must be at an enormous distance from the earth. According to Dr. A. W. Roberts, the density of the components cannot exceed 0.02 of the sun's density, and he finds that they "revolve round one another in *actual contact*." Assuming this density and a mass of 35 times the sun's mass for each component, I find that the diameter of each would be about $10\frac{1}{2}$ millions of miles. Now, comparing it with Algol, of which the diameter and mass are known, and assuming the same surface luminosity, I find that the parallax of V Puppis would be about $0''.0018$, or a light journey of about 1,800 years. As it lies in or near the Milky Way, it may possibly be one of the larger stars of the Galaxy. The parallax found above would indicate that the star is about 5,000 times brighter than our sun would be if placed at the same distance. The star is thus a very remarkable and interesting object. Its mass is very large, its density is very small, and the intrinsic luminosity of its surface is very high. Its distance from the earth is very great. Its orbital revolution is very rapid, and the variation of light is small and very regular. It is, in fact, one of the most remarkable objects in the heavens.

* *Monthly Notices*, R. A. S., June, 1903.

CORRESPONDENCE.

Creation of Species.

TO THE EDITORS OF "KNOWLEDGE."

SIRS,—Replying to Mr. Herbert Drake's letter in your March number, the strong hold which the "dogma of constancy of species" had obtained amongst theologians of that period is illustrated by the fact that Robert Chambers published "Vestiges of the Natural History of Creaton" anonymously, in order to avoid involving the firm with which he was connected in theological controversy, and the storm which followed Chas. Darwin's "Origin of Species" shows that this precaution was justified.

From the active part taken by Bishop Wilberforce and other prominent Churchmen of the time in this controversy, it would appear that the objections taken to the dogma can scarcely be dismissed as "popular prejudice or superstition," as suggested by Mr. Drake. There can be no doubt that the strong belief in this dogma held by the majority of the members of the churches, whether popular prejudice or not, delayed the advent of the theory of evolution.

One grave objection taken to the theory of evolution was that it did not accord with the literal reading of the first chapter of Genesis. This was also an important objection raised in the heated discussion which followed the publication of "Essays and Reviews," in which discussion many of our Bishops took a leading part.

J. C. SHENSTONE.

"Common" as a Scientific Term.

THE word "Common" is a useful one for ordinary use, but as a scientific term it has many disadvantages. Not the least of these is its ambiguity. We may say "the common snipe," or "the snipe is common there," or "the snipe is common to several countries," and use the word thus in three different ways, and not be sure that we shall be perfectly understood in any of them. I had always myself understood the expression "the common snipe" to mean the snipe that is ordinarily meant by the word snipe without qualification. But Mr. F. G. Aflalo ("KNOWLEDGE" vol. 2, p. 52) takes it to mean the "prevalent" species of that bird.

With regard to the Latin equivalents, *communis* in either of these senses simply is not Latin. It can only, in that language, mean common to two or more places. While *vulgaris* means "ordinary," "as used by uneducated people."

In this latter sense, which is I think the one in the minds of most people, one could well speak of "The Common Dodo," so as to distinguish the *Didus Ineptus* of Mauritius from the less well-known Didine birds of Rodriguez and Réunion. Yet Mr. Aflalo would deny its appropriateness to any species which is growing extinct.

Another objection to *vulgaris* is that it connotes the idea of popular error; it would be more appropriately used to stigmatise an incorrect title, than as a scientific distinction.

To introduce the term "common sense" in this connection seems like making "confusion worse confounded." We are given three derivations of the expression. First, a man's five senses were supposed to be the five avenues of one common organ, hence styled "the Common Sense." Next, there is the meaning of "the ordinary judgment of mankind." And then there is the philosophical definition, which makes it equivalent to the first principles of belief which ordinary men accept. None of these have anything to do with the Latin *communis sensus*, or the feeling common to all men as to what is right and proper. In actual use these various ideas are so confused that one can rarely meet two people to whom the word conveys the same meaning. I remember a scientist telling me that his common sense told him that miracles do not happen. I pointed out to him that whether that were an argument for or against miracles depended on the meaning attributed to "common sense." Once I heard, shortly after one another, two preachers, one of whom denounced, and the other pleaded for, the use of common sense in religion. They both meant the same thing, but used the term in contrary meanings! We need to be well on our guard against such a doubtful expression.

Verwood, Wimborne, March 13. HERBERT DRAKE.

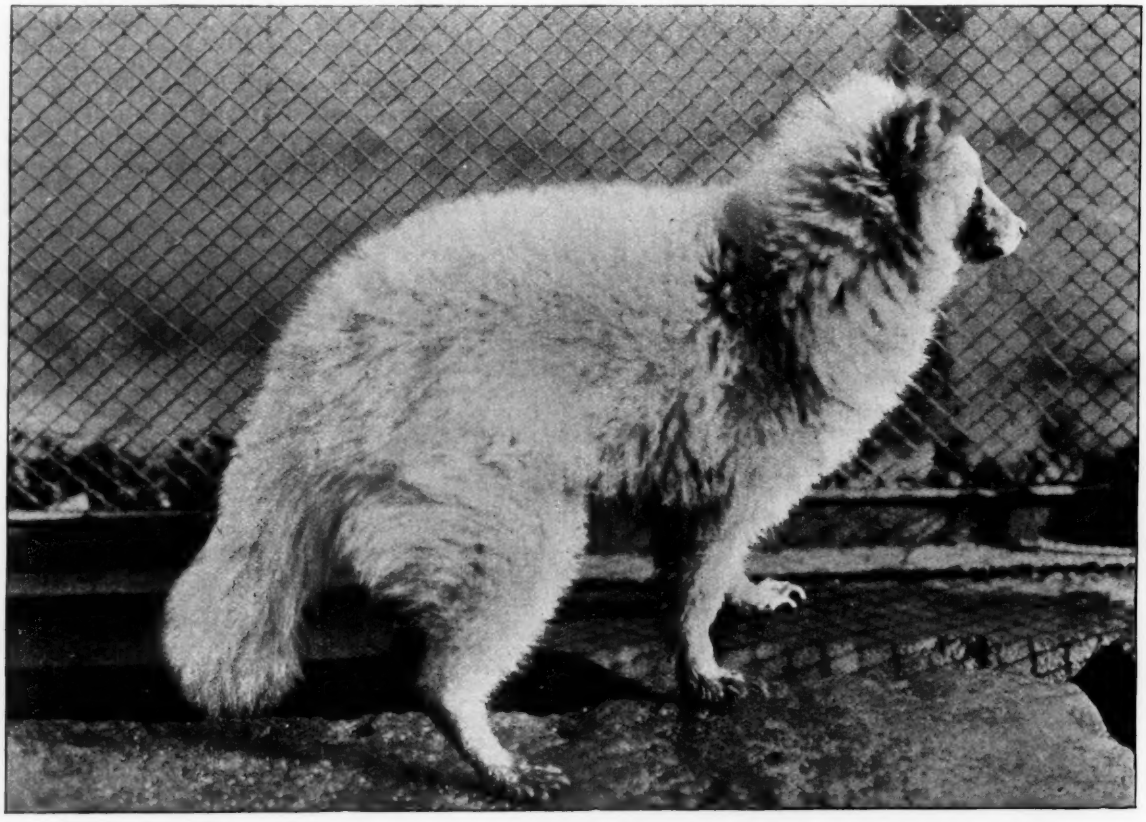
XUM

A White Raccoon Dog.

A New Species.

By EMILE GUARINI.

THIS strange specimen of dog was obtained by Captain Golding in Nagasaki, Japan, of a native dealer in live animals, who was unable to give its history, and could only state that it came from the northern portion of Japan. It bore a slight resemblance to an immature Arctic fox, but it was at once apparent that the creature was not a fox, and during the 15 months it has lived in the Zoological Park, of New York, it has not undergone any noteworthy change in pelage, nor has it perceptibly increased in size. It therefore seems conclusive that the creature is adult, and that its colours are constant throughout the year. An examination of its external characters revealed an unmistakable resemblance to the raccoon dog of Japan and China, but it is not an albino individual of this well-known species. There appears to be no escape from the conclusion that this specimen represents a species hitherto unknown.



White Raccoon Dog.

In general form this animal resembles a sharp-nosed raccoon. Its weight is 7½ pounds, its length of head and body 21 inches, the height at shoulders being 10.29 inches. The tail is 6.29 inches to end of vertebræ, and 8 inches to end of hair. The back is highly arched, its head is carried rather low, and its tail has a very raccoon-like droop. The feet are small and delicately formed, and the front feet in particular are short and weak. Although the claws are long, they are slender, remarkably straight, and have little strength, either for offence or defence. The ears are short, and in shape most nearly resemble those of the Arctic fox. As a whole, this animal is not physically robust, nor is it vicious in temper. Its teeth are small and weak, and it is poorly equipped for self-preservation. It requires a home that is not overrun by bears, wolves, foxes, &c., and very probably it inhabits moist lowlands rather than dry and rugged mountains. The feet are very thinly haired as if this creature had been specially fitted for life in swamps and tundras, where frequent wading in water is necessary.

On the neck, body, tail, and thighs the pelage is dense and fine, and consists of two coats. On the upper surface the inner coat is very fine and woolly, and about one inch long. The outer coat is two inches long, straight, and of coarser texture, as is usual in a rain-coat. The hair on the tail is abundant, but ends abruptly at the tip, like a tail artificially shortened. The pelage on the lower half of each leg is exceedingly scanty. On the abdomen the pelage is about one-half the length of that on the upper surface, and consists chiefly of the fine woolly under-fur. Excepting upon the feet and lower half of the legs, the pelage is like that of a small Arctic fox. The entire neck, body, legs, feet, and tail are pure white. On each side of the head is a large and conspicuous triangular patch of blackish-brown hair, the top of the muzzle is white, and the upper lip shows a light-coloured blending of brown and white. The forehead is white; the ear is conspicuously dark, the edge being quite black.

XUM

NOTES.

ASTRONOMICAL.

Secular and Seasonal Changes on the Moon's Surface.

FOR some years past Professor W. H. Pickering has been engaged in a series of special studies of the lunar surface. The work has been undertaken in connection with the Astronomical Observatory of Harvard College, and a full account of the results obtained will be found in volume 53 of the "Annals" of that institution. A short *resumé* has recently been presented in *Nature* over the signature of Professor Pickering.

Briefly summarised, it may be stated that the evidence of structural change on the visible hemisphere of our satellite has been suspected from time to time by various eminent selenographers, notably by Mädler, Schmidt, Webb, Elger, and Niesen. In more recent years the work of Professor Pickering during a long series of special observations in Peru, Jamaica, and California, has led him to the conclusion that physical changes do occur upon the moon, and that they may be classified under three heads, due respectively to (1) volcanic action, (2) formation and melting of hoar-frost, (3) growth and decay of vegetation.

The first class of phenomena has its most forcible example in the crater Linné, which, according to Lohrmann, Mädler, and Schmidt, prior to 1843, had a diameter of between four and seven miles, whereas its present diameter is three-quarters of a mile. A new crater has also been announced in the vicinity of the well known formation Hyginus. Again, the floor of the crater Plato has repeatedly furnished new formations under telescopic examination at various times. Pickering's latest observations show the existence of a crescent-shaped bank, about six miles long by one or two miles broad. Reference to the maps made by A. S. Williams during the period 1879-90, indicates that no object similar to that now existing was to be seen at that time; but the maps themselves show that slight variations were apparent at different epochs of observation.

Considering now the second variety of changes, there are numerous tracts on the moon's surface which exhibit variations in light and shade, which from their character lead to the assumption that they are due to the alternate condensation and volatilization of hoar frost. Professor Pickering especially draws attention to the evidences of aqueous erosion on the central peaks of Theophilus and Eratosthenes, and further considers that the strongest evidence for the former presence of water lies in the dried-up river-beds, of which the best example is to be seen on the eastern slopes of Mount Hadley, at the base of the Appenines. Another, discovered only in the summer of 1904, lies about 60 miles due south of Conon. Still more positive, however, is the evidence the author gives of personal observations of the periodical changes in the craters Messier and Messier A, according to the progress of the lunar day—changes which he asserts may be followed with a telescope of 4 inches aperture under good atmospheric conditions.

The third class of phenomena, possibly due to the growth and decay of vegetation, are stated to be more conspicuous than the effects produced by the two former causes. Reproductions are given of photographs obtained by Professor Pickering in the island of Jamaica in 1901, showing undoubted evidence of changes in the crater Eratosthenes, progressing very regularly with the age of the moon. Every precaution has been taken to exclude effects due to varying angles of lighting, and it remains quite certain that growths of dusky matter have taken place. As we have no knowledge of any mineral matter which could produce this appearance, it seems proper to ascribe it to vegetable growth.

Law of the Sun's Rotation.

Professor N. C. Duner, of Upsala, has within the last few years been engaged in a series of observations for the determination of the Sun's rotational velocity at different heliographic latitudes. The observations were made by determining the linear velocity at various points on the Sun's limb, by measures of the displacement of spectrum lines in the line of sight. In the latest list given he brings together results obtained from various determinations during the period 1887-1901. The following is a summary of the values found, taking zones of latitude of 15°.

Heliocentric latitude. ρ	Rotation Velocity at Limb. v	No. of Observation η	$\xi \cos \rho$	Angle of Daily Rotation. ξ
	K.M.		Degrees.	Degrees.
0·4	+ 2·08	183	14·770	14·77
15·0	+ 1·97	180	13 989	14·48
30·1	+ 1 70	184	12·072	13·95
45·0	+ 1 27	181	9·018	12·75
60·0	+ 0·81	183	5·752	11·50
75 0	+ 0·39	184	2·769	10 70

New Determination of Solar Constant.

Monsieur A. Hansky has recently published an interesting account of a series of determinations of the solar constant by actinometric observations on the summit of Mont Blanc. As given by various observers, this important quantity has been assigned many values, of which the following are the more important:—

Pouillet	1·763
Violle (Mt. Blanc)	2·54
Crova (Mt. Ventoux)	2·83
Langley (Mt. Whitney)	3·068
Savelieff	3·47
Angstrom (Peak of Teneriffe)	4·00

The two latter values are obviously too high in view of the more recent refined determinations. Later determinations with the bolometer by Langley gave the revised value of 2·54 as the more probable value.

M. Hansky's observations were made on the Mont Blanc station during the years 1897,1898, and 1900, giving the mean value of 3·29 as his final result. The series of 1900 were made under specially favourable conditions, and full details are given of that section. During twelve days' sojourn there he secured five actinometric curves, and numerous direct determinations of the solar thermal radiation, all of the observations being obtained with Crova's actinometer. From July 23 to 28 the weather was extremely fine, but the temperature high. The air was almost quite calm, but the aërial currents from the valley were evidently strong, as indicated by the formation of cumuli above the summit of the mountain. The hygrometric state at the summit was 70 per cent., indicating a vapour tension of about 1·2 mm.

The polarisation of the sky was about 0·50, and never exceeded 0·67; the colour of the sky was normal blue; barometric pressure varied from 426 to 430 mm.

The actinometric curves were very regular during the morning and evening hours, but showed strong depressions a little before and a little after midday (from 9 h.—1 h.), exactly as Crova had already found at Montpellier and Mont Ventoux. This depression may in part be attributed to the ascending air currents from the valley carrying with them large quantities of aqueous vapour, thus exerting considerable absorption of the calorific rays.

* * *

Seventh Satellite of Jupiter.

A telegram received from the Kiel Centralstelle on February 28, too late for inclusion in our last issue, announced the discovery of yet another satellite of the planet Jupiter, presumably by Professor Perrine, although the authorship was not mentioned.

The new satellite was stated to be of the 16th stellar magnitude, and its position when measured was

Position angle from Jupiter = 62° } D.
Distance = 21′ } 1905, February, 25·6

The daily motion was determined to be 6c″ of arc in a south-easterly direction.

Professor Campbell, in a later confirmation of the above, informs us that the discovery was made by Professor Perrine with the Crossley reflector of 36 inches aperture, and that the object had been under observation since January 2. The apparent motion of the satellite is direct, and the provisional elements indicate an orbit considerably inclined to the ecliptic.

CHEMICAL.

By C. A. MITCHELL, B.A. (Oxon.), F.I.C.

The Electric Bleaching of Flour.

A NEW electric process of producing an extremely white flour has recently been adopted in Paris. Specimens of the flour before and after the treatment have been examined by M. Balland, who finds that although the whiteness is undoubtedly increased, yet the flavour and odour are not so good as before. This is shown by the analyses to be due to a partial decomposition of the wheat oil, to which flour owes its aroma, and the flour increases greatly in acidity through this decomposition. In fact the process is essentially an artificial ageing accompanied by the usual whitening that occurs in old flour.

* * *

Radio-Active Substances in Natural Waters.

The water and the gases of the hot springs in Wiesbaden have been shown by Dr. Henrich to be strongly radio-active, whilst the stalactites also exhibited the same phenomenon. The water could be rendered nearly inactive by boiling it so as to expel the dissolved gases, but the stalactites retained their radio-activity on keeping. The element helium, which is known to be formed from radio-active substances, has been identified by M. C. Mouren in the gases from 12 French mineral springs, some of which contained 50 times as much as the others. Helium has also been detected by Sir James Dewar in the gases from a mineral spring in Bath.

* * *

The Gum Disease of the Sugar Cane.

The Australian sugar cane suffers from a disease which is characterised by the formation of a yellow gum within the vascular fibres of the plant. It was first described in 1893 by Mr. Cobb, who attributed it to a species of bacterium which he isolated from the gum, but his attempts to inoculate healthy plants with the disease were inconclusive. Professor E. Smith, however, has recently prepared pure cultivations of the micro-organism which he terms *pseudomonas vascularum* (Cobb), and has successfully inoculated common green sugar canes with them so as to produce all the symptoms of the Australian gum disease. The acidity of the juice appears to have considerable influence upon the susceptibility of the plant to infection, for two other varieties of sugar cane, Louisiana No. 74 and the common purple cane, with a much more acid juice, offered great resistance to the attack of the *pseudomonas*. The practical remedy of planting varieties of cane that are not readily affected has already given good results in the sugar plantations.

* * *

The Use of Specific Sera in Chemical Analysis.

One of the most difficult problems in analytical chemistry is to distinguish between the flesh or blood of different animals, and until recently the tests employed left much to be desired. In 1898, however, it was discovered by M. Borget that when a rabbit was inoculated with the serum of cow's milk its own blood serum became so modified as subsequently to give a precipitate when added to the serum (whey) of any cow's milk. This discovery was shown by Dr. von Rigler (1902) to be capable of extension, and that when rabbits were inoculated with extract or broth of a given animal the serum from their blood would then give a precipitate with extracts of the flesh of that particular animal, but not with those of any other animal. Thus sera rendered specific to horseflesh would not react with extracts of beef venison, pork, &c. A still more important development of this idea seems likely to effect a complete revolution in the methods of examination in criminal cases. For when human serum is injected into a rabbit or guinea-pig their sera become specific for human blood serum, and the test can be applied even in the case of a blood stain several months old. In a recent criminal trial in France the prisoner asserted that certain stains were caused by rabbit's blood. Sera specific for rabbit's and human blood were therefore prepared, and when it was found that a saline extract of the stain gave no pronounced reaction with the former, while it did so with the latter, the chemical experts considered that they were justified in reporting that the stain was certainly not rabbit's blood, but in all probability consisted of human blood. The nature of the specific substances in the sera is not known, but they are probably albuminous derivatives formed by certain constituents in the rabbit's cells in their attempt to expel the intruding substance. They can be precipitated and dried at a low temperature in a vacuum, and the *præcipitines* thus obtained only require the addition of water to produce a solution acting almost as readily as the fresh specific serum, and have also the great advantage that they can be kept in the dark for months without undergoing any change.

GEOLOGY.

Conducted by EDWARD A. MARTIN. F.G.S.

A Well-Boring at Holborn.

WATER to the extent of 3000 gallons per hour is being obtained from a new well at the Birkbeck Bank, Holborn, E.C. The strata passed through in the boring is as follows, kindly supplied by Mr. Heywood, of the firm of Messrs. Robert Warner and Co. :—

	FT.	
Alluvial	12	Basement.
	15	Ballast.
London Clay	85	London clay.
	15	Coloured clay.
Oldhaven	7	Sand and water.
Woolwich and Reading Beds	15	Coloured sandy clay and pebbles.
	2½	Sand pebbles and oyster shells.
	4	Sand and small pebbles.
Thanet sand	22½	Thanet sand and water.
Chalk	284	Chalk.

The well is sunk 5 feet into the chalk (5 feet diameter), lined with brickwork and iron cylinders; then an open sinking in the chalk for about 30 feet, and a boring in the bottom of the well to 462 feet. It will be seen that there is a total thickness of 178 feet above the chalk.

* * *

A New British Tortoise.

An interesting find is recorded from the lower Headon Beds of Hordwell, Hants, in the shape of bones of the carapace and plastron of a new species of tortoise. It has been given the name of *Nicoria Headonensis* by Mr. R. W. Hooley, F.G.S. The bones were scattered over a space of about four square feet, the broken edges of the entoplastral and right hyoplastral being found sticking out of the face of cliff. The specimen has been referred to the *Testudinidæ*, genus *Nicoria*, this being the first record of the genus from England. To-day it is found in the East Indies and in South America.

* * *

Maryland Miocene Formation.

The two new volumes of the Maryland Geological Survey, dealing with the Miocene deposits of that State, are models of what Government publications should be. Comparisons of these volumes with those issued by our own Survey are forced upon our notice, and we can only hope that in the course of time our own Government may be induced to make larger grants towards our half-starved Geological Survey. Of the two volumes now to hand, one contains over 500 excellently-printed pages of text, whilst the second volume contains 125 full-page engravings of fossils. The Miocene deposits of Maryland have long been known to geologists for the rich faunas

which they contain, and collections brought therefrom hav for many years enriched museums all over the world. Considering the barrenness of our own country as regards this formation, it is interesting to note that the Maryland Miocene shows a greater diversity of species than does the Eocene. The former are known as the Chesapeake group, from the superb sections seen on the shores of Chesapeake Bay. The group is divided into three well-defined formations, called Calvert, Choptank, and St. Mary's. They lie uncomfortably upon the Eocene, overlapping them along their western border. Beds of nearly pure diatomaceous earth, of between 30 and 40 feet thick, are met with in the lower portions of the Calvert formation; whilst the Chesapeake group, as a whole, is characterised by the great masses of molluscan shells which it contains, these forming sometimes so large a proportion as to produce nearly pure calcareous strata. The State Geologist (Mr. William Bullock Clark) and his assistants are to be congratulated upon the thoroughness and excellence of their work.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

Ivory Gull in Fife.

AN Ivory Gull (*Pagophila eburnea*) is reported, by the "Annals of Scottish Natural History," to have been seen in Largo Bay on Sept. 15. It flew past the observers so closely that "an excellent view of the pure white plumage, black eye, and yellow bill" was obtained.

* * *

Pied Flycatcher in Fife.

Two examples of this rare visitor to Scotland are reported in the "Annals of Scottish Natural History," as having been seen in Fife during May, 1904—one at Gilston on the 8th and one at Largo on the 12th. Both left on the 14th of this month.

* * *

Nutcracker in Kent.

At the meeting of the British Ornithologists' Club held on January 18, Dr. N. F. Ticehurst exhibited a nutcracker (*Nucifraga caryocatactes*), which had been killed on the 14th of that month by a gamekeeper at Benenden, in Kent. It proved, on dissection to be a male. This makes the fourth occurrence of this bird in Kent.

* * *

Sabine's Snipe in Anglesey.

A melanistic variety of the common snipe, known generally as "Sabine's snipe," was killed in a turnip-field in Anglesey on January 21.

* * *

A White Water Rail.

Mr. R. Patterson, in the *Irish Naturalist* for February, records the fact that a pure white water rail has just been shot at Seaforde, Co. Down. While the beak retained its normal colour, the legs and feet were of a pale pink orange. The bird was in splendid condition, and weighed 5½ ozs.

* * *

Little Auk at Portmarnock.

Mr. J. Turnbull, in the *Irish Naturalist* for February, reports the fact that a little auk (*Mergulus alle*) was picked up in an exhausted condition in a field at Portmarnock on November 27. This makes the sixth occurrence of this bird in Co. Dublin.

* * *

The Pacific Eider.

In our notice in February of the occurrence of the Pacific Eider (*Somateria V-nigra*), we inadvertently described it as having been shot at Scarborough. We learned, too late, that as a matter of fact it was killed at Graemsay, Orkney, in the early morning of December 14, by a wildfowler named George Sutherland, and was sent, with some common eiders, to a dealer at Scarborough.

The Migration of Birds.

We are glad to say that the British Ornithologists' Club has just appointed a Committee to inquire into the "migration of birds within these islands." The need for such an inquiry is now most necessary since this work has been relinquished by the British Association.

For the present observations are to be confined to the "arrival in England and dispersal through England and Wales of the thirty or so strictly migratory species which winter abroad and nest fairly commonly in England and Wales." Later, it is proposed to considerably extend the range of these observations.

Thus it is suggested that the services of lighthouse keepers should be enlisted, subject to the permission of the Master and Elder Brethren of the Trinity House. The keepers in question are to be asked to fill up schedules containing information as to the birds observed or captured at the lighthouses, and to forward the wings and feet of birds killed at the lamps. In short, they are to continue the work which has been so successfully carried on during the last few years by the Committee of the British Association.

Besides these helpers, other observers from a large number of centres in England and Wales are to be asked to co-operate, and to fill up similar schedules.

The fact that Mr. Eagle Clarke has promised to give his advice and help should go far to ensure success for this most valuable work.

* * *

The Study of Hybrids.

Hitherto the value of hybrid birds, from a scientific point of view, has been open to question, inasmuch as the parentage of the particular hybrids can never be positively demonstrated. Even when this parentage is known no great value can be attached to the fact. This is by no means the case, however, with the experiments now being carried out by Mr. J. L. Bonhote in his aviaries at Ditton Hall, Cambridge.

As a basis of operations he selected the Mallard, Pintail, Spotted-bill (*anas pœcilorhyncha*) and New Zealand Duck (*anas superciliosus*). The most interesting of the results so far obtained are those of the hybrids Mallard × Spotbill × Pintail. The offspring of this complex mixture of blood were divisible into two races—a light and a dark race. Of these the drakes in full plumage favoured the Mallard and Pintail about equally, whereas in eclipse plumage they resembled the Spotbill. The dark females have so far proved infertile, but this is not the case with the dark drakes when mated with pure bred birds of either species.

Though neither the Spotbill nor New Zealand Ducks have an eclipse plumage, when crossed with other species this peculiar phase is always assumed. Another interesting point which Mr. Bonhote's experiments have brought out is the fact that while some of these hybrids resemble the parent forms, others assume characters belonging to species which have had no part in their ancestry; or they develop features entirely new, that is to say, which can be referred to no known wild species.

The offspring of the light forms prove either as light as, or lighter than, their parents. As these experiments are still in progress it is probable that very substantial additions to our knowledge of hybridization will result.

* * *

A New British Bird.

At the meeting of the British Ornithologists' Club held on March 15 an adult male of the Snowfinch (*Montifringilla nivalis*) was exhibited by Mr. M. Nicholl. This bird was shot at Rye Harbour, Sussex, on February 22, and is the first recorded occurrence of this species in these islands. The Snowfinch bears a very striking resemblance to the Snow-bunting, and is a native of the mountains of Southern Europe extending eastwards to Palestine.

* * *

An Albino Shag in Orkney.

The *Field*, March 4, contains an account of a true albino of the Shag (*Phalacrocorax graculus*), which was obtained towards the end of December last near Stromness, Orkney. A similar example, according to the same authority, was obtained at Mid Yell, Shetland, on February 27, 1884.

XUM

ZOOLOGICAL.

By R. LYDEKKER.

An Asiatic Ocelot.

THE small marbled cats known as ocelots (*Felis pardalis*) have hitherto been regarded as an exclusively New World type, where they are most abundant in Central and South America. Re-examination of the Central Asiatic species known as *Felis tristis* has, however, led the present writer to believe that it is an Old World representative of the ocelots. If this view be correct, it will serve to show that the ocelots (as has always been supposed to be the case) originally entered America by way of Bering Strait. It is also urged that the clouded leopard (*F. nebulosa*) and the marbled cat (*F. marmorata*) of the Indo-Malay countries are also members of the ocelot group, but of a more aberrant type.

* * *

Arboreal Ancestral Mammals.

The majority of modern marsupials, it has been stated, exhibit in the structure of their feet traces of the former opposability of the thumb and great toe to the other digits; and it has accordingly been urged that all marsupials are descended from arboreal ancestors. This doctrine is now receiving wide spread acceptation among anatomical naturalists, and in a recent issue of the *American Naturalist* (November and December, 1904, p. 811) Dr. W. D. Matthew, a well-known trans-Atlantic palæontologist, considers himself provisionally justified in so extending it as to include all mammals. That is to say, he believes that, with the exception of the duckbill and the echidna, the mammalian class as a whole can lay claim to descent from small arboreal forms. This conclusion is, of course, almost entirely based upon palæontological considerations; and these, in the author's opinion, admit of our coming to the conclusion that all modern placental and marsupial mammals are descended from a common ancestral stock, of which the members were small in bodily size. To follow Dr. Matthew in his hypothetical reconstruction of these ancestral mammals would obviously be out of place on the present occasion; and it must suffice to say that, in addition to their small size, they were characterised by the presence of five toes to each foot, of which the first was more or less completely opposable to the other four. The evidence in favour of this primitive opposability is considerable. In all the groups which are at present arboreal, the palæontological evidence goes to show that their ancestors were likewise so; while, in the case of modern terrestrial forms, the structure of the wrist and ankle joints tends to approximate to the arboreal type as we recede in time. The available evidence, so far as it goes, is therefore decidedly in favour of Dr. Matthew's contention.

The author next discusses the proposition from another standpoint—namely, the condition of the earth's surface in Cretaceous times. His theory is that in the early Cretaceous epoch the animals of the world were mostly aerial, amphibious, aquatic, or arboreal, the flora of the land being undeveloped as compared with its present state. On the other hand, towards the close of the Cretaceous epoch (when the chalk was in course of deposition), the spread of a great upland flora vastly extended the territory available for mammalian life. Accordingly, it was at this epoch that the small ancestral insectivorous mammals first forsook their arboreal habitat to try a life on the open plains, where their descendants developed on the one hand into the carnivorous and other groups in which the toes are armed with nails or claws, and on the other into the hoofed group, inclusive of such monsters as the elephant and the giraffe.

* * *

A Fossil Loris.

The lorises or slow-lemurs, frequently miscalled sloths, are peculiar to the Indian and Malay countries, where they are represented by the slow-lorises (*Nycticebus*) and the much smaller slender lorises (*Loris*); the latter being restricted to Southern India and Ceylon. Their nearest living allies are the pottos (*Perodicticus*), of West Africa. Recently the well-known French naturalist, Mr. G. Grandidier, has described an extinct lemur from the Tertiary of France, which he believes to be nearly related to the slow-lorises, and has accordingly named *Pronycticebus gaudryi*. If the determination be correct (and the figures illustrating the memoir seem to indicate that it is), the discovery is of considerable interest, as tending to link up the modern faunas of Southern India and West Africa (which possess many features in common) with the Tertiary fauna of Europe.

* * *

The Lion in Greece.

Some time ago Professor A. B. Meyer, the Director of the Zoological Museum at Dresden, published an article on the alleged existence of the lion in historical times in Greece. A translation of this article appears in the recently issued Annual Report of the Smithsonian Institution. As regards the mention of that animal in Homer, the author is of opinion that the writer of the Iliad was probably acquainted with the lion, but this does not prove its former existence in Greece. The accounts given by Herodotus and Aristotle merely go to show that about 500 B.C. lions existed in some part of Eastern Europe. The Greek name for the lion is very ancient, and this suggests, although by no means demonstrates, that it refers to an animal indigenous to the country. Although fossil bones of the lion have been recorded, no recent remains of that animal are known from Greece; but this cannot be regarded as a matter of any importance in connection with the question. On the whole, although the evidence is not decisive, it seems probable that lions did exist in Greece at the time of Herodotus; and it is quite possible that the representation of a lion-chase incised on a Mycenean dagger may have been taken from life. In prehistoric times the lion was spread over the greater part of Europe; and if, as is very probable, the so-called *Felis atrox* be inseparable, its range also included the greater part of North America.

It may be mentioned that the journal above-mentioned also contains a translation of an article giving an account of the discovery of the mammoth carcase recently set up in the St. Petersburg Museum. In publishing translations of articles of such general interest as the above, the Smithsonian Institution is doing good service to science, for although many of us have a more or less intimate acquaintance with German, it is but few who can read Russian or Norwegian.

* * *

Fish-Lizards.

Many years ago the present writer contributed to "KNOWLEDGE" a popular account of the extinct marine reptiles known as ichthyosaurs, or fish-lizards. The same group has afforded to Professor H. F. Osborn the subject for an exquisitely illustrated article in the January number of the *Century Magazine*. These creatures, as anyone may satisfy himself by a visit to the Natural History Museum, had paddle-like limbs of a most peculiar type; but Professor Osborn is of opinion that these may be derived from a limb of the type of that of the living New Zealand tuatera, a primitive terrestrial lizard. Owing to the remarkable state of preservation of some of their fossil remains, we know not only that fish-lizards had a fin on the back, and another at the end of the tail, but likewise that they possessed a smooth skin and produced living young; the latter feature being an adaptation to their purely aquatic mode of life.

* * *

New Species of Wapiti.

IN the *Proceedings* of the Biological Society of Washington of February 2 Dr. C. H. Merriam describes the wapiti deer, or elk (as it is miscalled in America), of California as a new species, under the name of *Cervus nannodes*. It differs from the typical wapiti of the Rocky Mountains by its inferior size, relatively shorter legs, and paler colour, the front of the limbs being golden tawny in place of black. Of course this animal is not a species in the sense in which that term is employed by many naturalists, but merely a local race.

* * *

The Paddles of the Fish-Lizards.

Mr. J. C. Merriam, in the *American Journal of Science* for January, shows that so early as the period of the Trias, or New Red Sandstone, the fish-lizards, or ichthyosaurs, displayed two distinct types of paddles; the one broad and the other narrow. The broad-paddled type (*Mixosaurus*) is considered to be the

one from which both the broad-paddled and narrow-paddled forms of the Lias have originated, thus upsetting the older view as to the narrow-paddled group being the primitive type.

* * *

Cobra Poison.

An important communication on the action on the human system of the poison of the Indian cobra is published in a recent issue of the *Philosophical Transactions* of the Royal Society, based on investigations undertaken at the instance of the Secretary of State for India by Surgeon-Captain Elliot. While earlier investigators ascribed death from cobra-venom in most cases to paralysis of the respiratory centres, the author concludes that the main cause is a rise of blood-pressure caused by the contraction of the minute arteries, which thus afford a barrier to the circulation.

* * *

Papers Read.

At the meeting of the Zoological Society on February 21, Mr. Lydekker contributed one paper on the giraffes of Nigeria and the Kilimanjaro district, and a second on dolphins from India. Messrs. Thomas and Schwann gave an account of a collection of South African mammals, describing a new species of shrew; and Mr. Pocock pointed out that the Somali kudu was subspecifically distinct from the typical southern form of that animal. On March 7, at the meeting of the same Society, notes were contributed on the marine fauna of the Cape Verde Islands, Mr. Regan reviewing the species of certain South American genera of fishes; and Captain Meinertzhagen described a new kind of oribi antelope from British East Africa. At the meeting of the Linnean Society on March 2, the subject of zoological nomenclature was discussed, and the hope expressed that tautonomies, such as *vulpes vulpes* and other comical arrangements, would be discarded.

* * *

It is generally understood that insects, like other "cold-blooded" creatures, have no temperature of their own, but put themselves in equilibrium with that of the surrounding medium, air or water. M. Acloque summarising in *Cosmos* recent investigations on this subject, suggests, however, that there are several experiments to show that the generalisation is not true in all cases, and that there are reasons for supposing that insects produce heat. A Fahrenheit thermometer was found by Inch to rise seven degrees in an ant-hill, and Swammerdam and Réaumur observed that the temperature of beehives keeps above that of the external air in winter. According to Huber, who repeated these observations, this temperature is nearly constant at 88° Fahrenheit. Réaumur added that when the bees were agitated they caused their wings to vibrate with great rapidity, and the interior heat then increased to such a point that the walls became warm, and sometimes even the wax melted. However this may be, we may say that the heat given off individually by insects is always very slight. By way of compensation, they confirm the general law according to which living creatures resist cold better as their ability to give off heat is slighter. Caterpillars do not necessarily die when turned into bits of ice; and this resistance to cold explains why we can find insects in regions very near the Pole, and why the rigours of our own winters do them so little injury. Certain species, and in particular some lepidoptera, hatch out only in winter, which explains again, perhaps, how it is that some flowers like the yellow Cape jessamine, now blooming in Surrey, can become fertilised in winter. Insects bear heat as well as cold, and Kirby and Spence have affirmed that some can survive immersion in boiling water.

SCIENCE YEAR BOOK.

Attention may be called to the announcement that appears in our advertisement pages of the Reduction in price of the Science Year Book for 1905. This should be an opportunity for all persons interested in Science to acquire, at a very small cost, this book which *Nature* says "should be found on the writing table of every astronomer and meteorologist," and "all who are interested in natural phenomena or concerned with scientific progress."

REVIEWS OF BOOKS.

Terrestrial Magnetism and its Causes, by F. A. Black. (Published by Gall & Inglis; price, 6s. net). The complex question of the magnetism of the earth and its consequent influence on the compass needle has been treated from an entirely new basis of hypothetical speculation by Mr. F. A. Black, in this recent work. The elucidation of the natural laws which cause the magnetic needle to point approximately North and South; the daily, seasonal, and secular variation in its direction, and in its inclination or dip; the causes of magnetic storms and their connection with sun-spots and auroræ; in short, every subject connected with the earth's magnetisation and its influence on the magnetic needle is dealt with by the author in the theory promulgated by him. He adopts the assumption, based on scientific opinion, that a tenuous medium of an electrical nature permeates the space through which the earth moves in its orbit; that the sun's activity causes displacements or currents of this medium which are impelled with great velocity towards and upon the earth, thus causing the earth in its diurnal rotation to be enveloped from apex to apex by a sheet of electricity with an apparent contrary motion, so that it is magnetised by induction, and is consequently an electro-magnet. The various puzzling phenomena connected with the magnetic needle in relation to the earth's magnetism are treated in an exhaustive manner, and the deductive reasoning proved by means of diagrams. The book is unmistakably the result of deep study and research on the part of the author, and the able arguments set forth in support of his theory are undoubtedly well worthy the consideration of magnetists, physicists, and others interested in this department of science.

Astronomy for Amateurs, by Camille Flammarion, translated by Francis A. Welby (Fisher Unwin). Price 6s. 340 pp. This is one of those fascinating little books that do so much to spread scientific interest among the people. Being written by so well-known an astronomer and author, it should have an even wider interest than many other books of its kind. Much of it is almost poetic in its imaginative descriptions, and the translation has been most successfully carried out. It is, however, a pity that some of the illustrations do not follow suit. They may be poetic and imaginative—many are of young ladies in flimsy attire gazing at the hazy heavens—but they are neither artistic nor descriptive. The "Contents" includes an "Introduction" and an "Index," but neither of these desirable addicions appears in the print.

Popular Star Maps, by Comte de Miremont, F.R.A.S. (G. Philip and Son; price 10s. 6d. net.) These maps, with an introduction to explain the principle employed in projecting them, short account of "Star Nomenclature," and lists of stars shown in the maps, both in alphabetical order and in order of Right Ascension, certainly form "a rapid and easy method of finding the principal stars." On the other hand, this work forms a somewhat bulky and elaborate apparatus for so simple a requirement. Ten large plates are given, in which the white stars stand out well on a dark blue ground, each with its key map. Yet only the brightest stars are depicted, with but few smaller than the 3rd magnitude. The constellations are thus distinctly portrayed for the novice in astronomy, but for those seeking more detail there is little information.

Chemistry in Daily Life, translated from the German of Dr. Lassar Cohn by M. M. Pattison Muir, M.A. (Grevel and Co.; price, 5s.). This is the third edition of a cousre of thoroughly practical lectures, which should be widely read as giving a most necessary addition to the education of the average Englishman. It would be hard to beat this little work for simplicity and clearness of language and great scope of its teachings. The latter may be made evident from a glance at the table of contents, which includes: Analysis of air, breathing, combustion, matches, candles, oils, petroleum, coal gas, incandescent gas lights, electric furnace, food of plants, manures, food of men and animals, diets, digestion, wines, explosions, fabrics, leather, dyeing, painting, inks, acids, soaps, glass, bricks, photography, X-rays, metals and alloys, and many other items. It must be acknowledged that to have some scientific knowledge on all those every-day subjects is both of great interest and undoubted utility, and a man who can pack the information contained in this book into his brain will, in our opinion, be of far

XUM

more practical use in the world than he who has devoted the same amount of time to a study of Greek. We commend the book especially to school-masters and others interested in the education of boys and young men, but none the less do we advise all those who are not well up in these subjects to dip into the book, after which their interest is sure to be aroused, and the work read from cover to cover.

Remarkable Comets, by W. T. Lynn; 12th Edition, Revised. (Sampson Low, Marston, and Co., Limited; London, 1905; p.p. 46; price 6d.). Our astronomical readers are, no doubt, acquainted with this concise summary of the more interesting facts in the history of cometary astronomy, and the present edition, the twelfth, brings the account up to date. As in former editions the author restricts himself to the appearance and reappearance of comets and their periodicities, and only refers in a very brief manner to the relationship between comets and meteor-swarms. The physical characteristics are, as usual, almost neglected, lying outside the scope of the survey. As the book is intended as a handy book of reference to comets which may be considered remarkable, its value would be very much enhanced if, in future editions, a brief bibliography were added at the end. This would most certainly assist those who wish to learn more about comets than that which is contained in these pages, and would be very efficiently done if compiled by the author of this excellent little treatise.

A Revised System of School Teaching, by Richard Chichester (H. J. Glaisher; 1s. net). This is a pamphlet describing a new system which might be adopted in schools. The idea is founded upon the fact that "so often a boy, on reaching a high class, being asked a comparatively simple question, answers that he never learnt it" (presumably meaning the answer). When such an occurrence is frequent, reform is certainly needed, but we should have thought it exposed a fault in the detail of teaching rather than in the principle. An idea well worthy of consideration is here suggested, which is that, instead of boys being placed in one "form" or "class" for all subjects, "Divisions" should be formed for instruction in each particular subject. All schoolmasters should read this pamphlet, which may suggest to them some useful wrinkles.

A List of English Clubs for 1905, by E. C. Austen Leigh, M.A. (Spottiswoode and Co.), will often be found of great use, containing as it does not only details of all the London and Provincial Clubs, but also those of English Clubs all over the world, with membership, subscriptions, &c.

China Decoration and Repair, by Rev. F. C. Lambert (Dawbarn and Ward; 6d.), is a useful little guide, but contains some very inartistic designs.

The Children's Book of Moral Lessons, by F. J. Gould (Watts and Co.; price 6d.). The moral instruction of children is too frequently sadly neglected, and Biblical History supposed to suffice in this respect. The little work before us is an attempt to impart such moral instruction under the guise of short anecdotes.

Williams and Norgate's **International Book Circular** is practically a bibliographical *résumé* of the world's best literary productions in all branches of science and learning published during the last few weeks, and as such will be found of great value to students of science.

How to Build a Lathe. By A. W. Burford, A.M.I.C.E. (Dawbarn and Ward), price 6d. net. (cloth 1s.), forms No. 9 of the series of "Utility" Practical Handbooks, some of which we have already noticed. To build up a lathe from the raw materials is instructive as well as being a cheap means of obtaining a valuable possession. The instructions herein given are very practical, and a number of diagrams add to the explanations in the text.

Lessons in Experimental and Practical Geometry. By H. S. Hall, M.A., and F. H. Stevens, M.A. (Macmillan), price 1s. 6d. It is perhaps quite sound, though not altogether in keeping with practice, "to give to a young pupil clear mental pictures" of geometrical principles. To graphically explain what is meant by lines, planes, angles, and all the other constituents, the consideration of which go to make up geometry, is the object of this little book. The idea is well carried out, and we can confidently recommend this brochure to teachers of elementary Geometry.

An Improvement in the Wimshurst Machine.

By CHARLES E. BENHAM.

MANY years ago the late Mr. Wimshurst established the fact that the electric influence machine which he invented will work without the tinfoil sectors if large brushes are used and if the varnish on the plain plates is new. Under such conditions the machine is not only self-exciting, but the sparks are even longer than when sectors of tinfoil are present. The reason for the increase in spark-length is no doubt the greater immunity from leakage. On the same, or, rather, the converse principle, the increase of the number of sectors diminishes the length of spark on a Wimshurst by increasing the leakage. It is obviously inconvenient to be constantly renewing the varnish on the glass plates, so that the sectorless Wimshurst, though interesting for exhibition as a class-room experiment, is not adapted for practical work. By a simple expedient, however, the efficiency of the machine may be increased and the required immunity from leakage reduced to a minimum without altogether doing away with the sectors and rendering the self-excitement dependent on the condition of the varnish. The way to do this is to make every alternate sector of a semi-conducting substance instead of tinfoil. Thin white card seems to answer best. The cardboard sectors may be larger than the intermediate tinfoil sectors. The only reason why cardboard alone cannot be used is that self-excitement is not assured, especially in very dry weather. Very narrow sectors of tinfoil between the card sectors will ensure the self-excitement, and as soon as the potential increases, the semi-conducting card acts fully as efficiently as metal, with the advantage that there is considerably less leakage and a longer spark. The arrangement is equally efficient in all sorts of atmospheric conditions, a small vulcanite-disc machine of eight inches diameter responding promptly after being left for some hours near an open window on a damp, foggy day, and giving at once strong sparks of 2½ inches length. The cardboard sectors on each plate of this machine number 16, and a narrow tinfoil strip is placed between each two. The cardboard should be attached firmly with strong glue, the corners of the sectors being carefully rounded with scissors before they are fixed to the plate. Working the machine at full strain, with the dischargers wide apart, in the dark, its immunity from loss by leakage is at once apparent.

Acetylene as an Explosive.

M. GUEDRAS has been experimenting in Paris with acetylene as an explosive. The carbide is granulated and charged in a special form of cartridge, consisting of an iron-cylinder, in the bottom of which the carbide is placed. Above this is stretched a membrane, and the top is filled with water. A rod is so fixed in the cartridge, that when its end is struck it pierces a hole in the membrane, which lets the water on to the carbide, and acetylene gas is formed. The charge is fired by an electric fuse inside the cartridge.

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Toning with ferricyanides.—It is very desirable, at least for the serious worker, to know exactly what chemical changes take place during photographic operations, so that the operations may be intelligently controlled and the character of the product understood. It was therefore with a pleasurable expectancy that I read a few weeks ago a communication from Messrs. A. and L. Lumière and A. Seyewetz on the composition of the resulting image when a silver image is toned by means of a solution of potassium ferricyanide mixed with either a ferric, copper, or uranium salt. But it is with a feeling of disappointment that I refer to the paper, for the authors appear to have done little more than begin to find the difficulties of the investigation. They show that when finely divided metallic silver is acted on by a solution of potassium ferricyanide, the silver does not simply attach itself to the ferricyanide to form a double ferrocyanide, thus—

$$K_3FeCy_6 + Ag = K_3AgFeCy_6,$$

but that two salts are formed,

$$4\ K_3FeCy_6 + 4\ Ag = Ag_4FeCy_6 + 3\ K_4FeCy_6,$$

and that the potassium ferrocyanide may be washed away, leaving the silver ferrocyanide. But when the metallic silver is suspended in a gelatine film, as it is in an ordinary developed image, they get a quite different result by the action of potassium ferricyanide upon it. The product then contains about twice as much iron as it ought in proportion to the silver, after allowing for a very small quantity of potassium which appears to be due to incomplete washing. The presence of this extraordinary proportion of iron (or deficiency of silver) remains a mystery.

When the ferricyanide of potassium is mixed with ferric citrate as in iron toning or blue toning, the ferric ferricyanide produced might be expected to combine with silver directly forming silver ferric ferrocyanide ($AgFe^{III}FeCy_6$), or if the potassium ferricyanide first forms silver ferrocyanide as shown above and this reacts with the ferric citrate, the silver might be entirely replaced by iron and Prussian blue result ($Fe_4(FeCy_6)_3$). But the analysis of the product shows about five times as much silver in proportion to the iron as represented by the first formula. Probably a large amount of the silver in the original image is unattacked.

When a copper toning solution is used we might similarly expect to get either a double ferrocyanide of copper and silver ($Cu_3Ag(FeCy_6)_2$) or merely ferrocyanide of copper (Cu_2FeCy_6), a chocolate coloured substance to which the colour produced on toning is generally supposed to be due. A considerable quantity of silver was found but the proportion of iron was nearly double that required according to either formula. The approximately double proportion of iron in this case, and also when the simple potassium ferricyanide acts on finely divided silver in gelatine, seem to point to a reaction that would repay investigation.

Variations in Platinum Printing.—The platinum process has many advantages, the chief of which are the permanency and the beauty of the results that it furnishes. But to let well alone is not the nature of photographers, and it is too often the case that those who try to improve processes have only an empirical knowledge of them, and know nothing about the suggestions that they make and the modifications that they propose, except that the prints they get are different from ordinary prints. The methods initiated by such workers must always be unsafe until they have been properly investigated.

The image in a platinum print consists of metallic platinum, and therefore it can only be affected by adding something to it. Many methods of toning, and so on, have been suggested, but they all, except perhaps one in which gold is used, consist in depositing upon the image substances that cannot be compared with platinum for permanency. No reliance can be placed upon such compound images, and it is not right to call them platinum prints, for the great advantage of platinum, its unchangeableness, has been compromised. By adding a small proportion of certain salts, especially salts of mercury, to the mixture with which the paper is coated, or, less advantageously, to the developing solution, the colour of the deposited platinum may be modified to a warmer tint. This applies particularly to hot development. Here also the image consists, I believe, of pure platinum, for it behaves as if it were so, and neither metallic mercury nor mercurous chloride can exist in contact with the platinum salt without immediately depositing metallic platinum. The paper supplied commercially for sepia prints gives images that seem to be as unchangeable as the ordinary black platinum image. But suggestions have been made and formulæ given for adding comparatively large quantities of extraneous salts to the coating solution or the developing solution, and there is practically no doubt that in many of these the limit of safety has been passed and the image is not platinum and not permanent. I believe that it may be truly stated that if the image is affected by any reagent that the paper it rests on will withstand, it is not a genuine platinum print. Such reagents as hydrochloric acid, chlorine water, and potassium cyanide may be used.

Received.—The Thornton-Pickard Company send their new catalogue, in which the important novelties described are the "Royal" shutter, similar to their "Standard" "time and instantaneous" shutter, but with the mechanism inside the case, and so protected from dust and other damage; and a bellows-form of ball compressor, which is better than the simple ball in that it delivers always the same volume of air, and thus contributes to the uniform working of the time exposure valve. A prize competition is announced.

Mr. William Hume, of 1, Lothian Street, Edinburgh, publishes a list of his enlarging apparatus in their many varieties, and with almost innumerable accessories, including also valuable suggestions as to the selection and using of them; indeed, it is a guide book as well as a list. The application of modern illuminants such as acetylene, arc lamps, Nernst lamps, and incandescent gas, as well as oil lamps and the limelight, are fully dealt with. Mr. Hume was the first to use the word "cantilever" in this connection as a "selling name," and has specialised in enlarging apparatus since the year 1888.

Messrs. Taylor, Taylor, and Hobson, of Leicester, have just published their new catalogue of lenses, &c., which includes other items of information likely to be useful to photographers, and will be sent to any applicant who mentions the name of this journal. They have introduced two new series of Cooke lenses. Series II. are portrait lenses with a maximum aperture of f/4·5, and will give sharp or softened definition at will. Series IV. have an aperture of f/5·6, and are specially suitable for high-speed shutter work in general.

Messrs. Kodak are again inviting competition for several valuable money prizes for work done with Kodak apparatus and materials. About one half are reserved for those who have not yet won a prize in such competitions. Entries will be received up to the end of September, and full particulars may be obtained from the Company.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Fibrous Constituents of Paper.

(*Continued from Page* 68.)

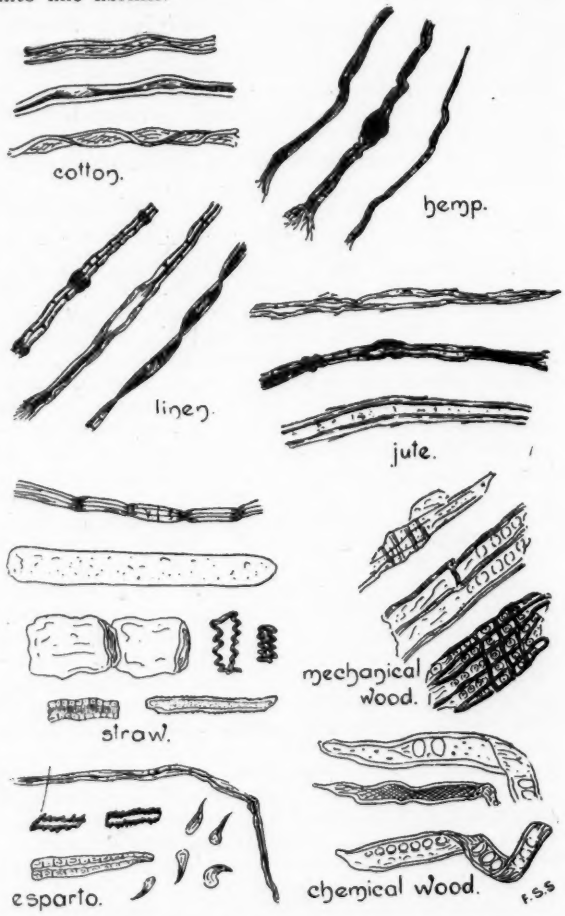
CHLOR-ZINC iodine gives a characteristic bluish violet reaction with cellulose, becoming reddish-brown to claret-coloured for rag and similar fibres, and light to dark yellow for lignified fibres. We have thus a ready means of distinguishing the fibres by their colour reactions alone, which we may summarise as follows :—Linen, cotton, hemp, reddish-brown to claret; esparto, straw, and chemical wood-pulp, bluish-violet; mechanical wood-pulp and jute, yellow. Jute may be more blue than yellow, whilst manilla hemp—an entirely different fibre to hemp itself—will be blue rather than red.

With polarized light the fibres also behave differently. The nicols being crossed so that the field is dark, it will be seen that linen and hemp give a brilliant play of colours, especially if the microscope has a stage which can be rotated; jute gives these colours in a rather less degree, cotton or wool still less; whilst esparto, straw, and wood-pulp are colourless. It will be observed also that the various structural details of the fibres are brought out very clearly by this method, and this is of service in making the final examination, as it will be observed that neither the chlor-zinc iodide differentiation nor that with polarized light are necessarily quite determinative.

The examination of the structural differences of the various fibres is, however, the most difficult of all, and requires more experience than is apparent at first sight, not a little of the difficulty being due to the rough treatment the fibres have undergone as already mentioned. A study of the accompanying illustrations will assist the reader in following the description.

Cotton shows flat, ribbon-like fibres with a large lumen about two-thirds of its total diameter, so that the cylinder, being weak, has collapsed in places and thus given rise to a sort of spiral twist which forms the most characteristic distinction of this fibre. It should be noted, however, that the boiling in caustic soda largely counteracts this twist, as does the breaking up in process of manufacture, so that the absence of the twisted appearance does not necessarily decide the question. The fibres also show fine, lattice-like markings, and it will be observed that they are free from thickening or knots. The ends are often laminated. Taken altogether, the wide lumen, the spiral twist, the markings, and the freedom from knots form characteristic features which make cotton one of the easiest fibres to distinguish.

Linen and hemp are so much alike that it is almost impossible to distinguish them, but they are not often found in the same classes of paper, or where identification and separation from each other is necessary. The fibres are smaller than those of cotton—about half as thick—and they have a very small lumen, so small that it often appears little more than a narrow central line. In places, however, the pressure which the fibre has undergone during pulping may have flattened out the central canal so that it bears a strong resemblance to a jute fibre or even to cotton. The frequent thickening into knots is very characteristic, but otherwise the fibre is fairly uniform in thickness, and cylindrical. There are also numerous dark cross lines which come out well under polarized light. The ends are often drawn out into fine fibrillæ.



Jute fibres have a peculiarly uneven appearance. The wall is thick and thin in places, and the central canal varies proportionately in width from a thin line to a canal as broad as that of cotton, and all these changes may be observed without moving the slide. They also show cross-striations and knots, but less frequently than linen or hemp. Jute is a very intractable fibre, and accordingly the fibres will be often observed sticking together in parallel bundles. It is most difficult to bleach, and its use is, therefore, almost entirely confined to coarse papers.

Straw fibres are smooth and even, cylindrical, uniform in diameter, and with a central canal of varying size, but at intervals knots appear. Striations are

likewise seen. A certain number of flat, oblong cells from the parenchyma are always found in papers made from straw, and ring-like portions of spiral and annular vessels may also be found, but the most characteristic features are the numbers of finely-serrated epidermal cells, which are thick-walled with jagged edges. They must, however, not be confused with the somewhat similar cells in esparto.

(*To be Concluded.*)

Royal Microscopical Society.

February 15, at 20, Hanover Square, the President, Dr. Dukinfield H. Scott, F.R.S., in the chair, the Secretary read Mr. Finlayson's description of the Ashe-Finlayson Comparascope. This is an apparatus designed to show two images side by side in the microscope for comparison, and consists of the attachment to any ordinary microscope of a second objective, stage, and illuminating apparatus, placed on one side at right angles to the optical axis of the microscope. On the nosepiece of the latter is screwed a short tube with a circular aperture at one side, and containing a reflector extending half-way across, placed at an angle of 45° to the axis of the tube. The subsidiary apparatus is applied at this aperture, the reflector thus transmitting the image of the second slide to the eye-piece. The reflector utilises half the diameter of the tube, the other half serving for the passage of light from the primary objective direct to the eyepiece. A diaphragm or division plate extends up the tube from the reflector almost to the eyepiece to prevent overlapping of the images, which appear together as two semicircles, equally distinct. Mr. C. Beck exhibited a new optical bench for microscopic illumination, photo-micrography, micro and lantern projection, and a large micro-photographic and enlarging camera, both bench and camera being mounted on special tables. Mr. J. E. Stead, F.R.S., delivered the first part of a lecture on "Practical Micro-Metallurgy." He alluded to Dr. Sorby's pioneer work on this subject some forty years ago. Dr. Sorby's method was very simple, a small piece of metal being ground down to a flat surface, and finally polished on various grades of emery-paper, finishing with rouge parchment. This method was still adopted, but by means of special machinery the process was reduced from two or three hours to five minutes. Mr. Stead described this machinery, and explained the various processes of cutting, grinding, and polishing, also the different methods of preparing the polished surface so as to render the structure visible, their mounting, and also suitable illumination. The lecture was illustrated both by lantern slides and by actual specimens, the beautiful colours due to heating being shown in a quite novel way.

The Quekett Microscopical Club.

The 420th ordinary meeting, which was also the annual meeting, was held on February 17 at 20, Hanover Square, the President, Dr. E. J. Spitta, V.P.R.A.S., in the chair. The annual report and balance sheet were read, and gave evidence of a larger membership and improved financial position as compared with the previous year, the number of new members elected during the year being 50, whilst the total membership amounted to 382. Dr. E. J. Spitta was re-elected President, and all the other officers were also re-elected, except that Mr. J. J. Vezey, F.R.M.S., was elected as a Vice-President instead of Mr. George Massee, F.L.S., who retires. Mr. A. D. Michael, F.L.S., delivered the annual address, dealing with "Improvements Effected in Modern Objectives," with special reference to the various corrections necessary for both objectives and eyepieces, the use of Jena glasses, and their results, as evidenced in the apochromatic lenses and the improvement in achromatic lenses, which justify their description under a new name as semi-apochromatic.

Notes and Queries.

Bausch and Lomb's Portable Microscope.

With reference to my notice last month of this microscope, and my remark that in the instrument sent me the condenser did not quite come into focus, I am informed that this is purposely put out of focus to prevent the upper and auxiliary diaphragm being damaged by accidentally coming in contact with the condenser top, and that by means of a screw thread in the condenser mount the optical part can, if required, be brought level with the stage. But as it is a primary requirement that a condenser should readily focus, it seems to me that this is an undeserved concession to careless workers, the more so as the upper diaphragm and the condenser are not generally used together. A preferable way, if the upper diaphragm is retained, would be to alter the construction of the condenser so as to give it a slightly longer focus. In the meantime, it is only fair to Messrs. Bausch and Lomb to add this explanation.

C. A. Winckworth (*Brighton*).—I think that from your description there can be little doubt that what you have observed was merely an amœba undergoing division. Under any circumstances, they could not be bacteria.

Dr. W. J. Branch (*St. Kitts*).—Your question touches on a matter which has exercised many minds, but only through a misapprehension of the true principles involved. Assuming that you could have a film that showed no grain under the highest magnification, you could, of course, easily enough magnify an image photographically impressed upon such a film, and repeat the process as often as you wished, but in each stage you would be merely magnifying what existed on the original film. Now what you had upon the first film depends on the aperture of the lens through which the photograph was taken—in other words, the aperture of the lens governs its resolution, and you would get no more *detail* by subsequent magnification. So that the mere fact that you enlarged a fine, but perfectly distinct, line into a broad and coarse one would be useless. The experiments you allude to tend to make fine detail resolved by the objective more evident to the eye, but that does not affect the issue.

Miss F. Elliot (*Staines*).—I much regret that pressure on my space prevented my answering your query last month. *Hircinia variabilis* is a horny sponge, very variable in shape, as its name implies. The simplest forms are incrusting, horizontally expanded, and more or less cake-shaped. It often grows more vertically than horizontally, and attains an irregular globose form. Sometimes, owing to uneven rapidity of growth, rugose, tubercular, or even lobose forms are produced, but in any case the sponge appears as a crust from the upper surface of which these processes arise. The crust is sometimes much curved, raised in the centre, and attached at the margins only. The surface is covered with conuli, the oscula are large and conspicuous, and the colour light to dark brown in the living state. The sponge consists of slightly fascicular main fibres, joined by connecting fibres which form a mesh or net-work. There are several varieties, several of which are found in the Adriatic, and it is found also in the Pacific Islands, India, Australia, Jamaica, Florida, &c. For the life history of sponges I am afraid I must refer you to any good book on Zoology, and unless I know more exactly what you wish specially to examine I can scarcely advise you as to methods. You might begin with a little dissecting, and then cut sections by hand. "Knowledge" is the only English journal which deals systematically with Microscopy, and I regret with you that the space at my disposal is not larger, but I will gladly give you any assistance in my power.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

The Face of the Sky for April.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 5.38, and sets at 6.31; on the 30th he rises at 4.37, and sets at 7.19. The equation of time is negligible on the 16th. Sunspots and faculæ are usually conspicuous on the solar disc, marking a return to maximum activity, whilst prominences also continue to be numerous.

For plotting the positions of spots, &c., the following table gives the necessary data:—

Date.	Axis inclined from N. point.	Equator N. of Centre of disc.
April 1 ..	26° 23′ W.	6° 28′
,, 11 ..	26° 23′ W.	5° 47′
,, 21 ..	25° 45′ W.	4° 58′
May 1 ..	24° 20′ W.	4° 0′

THE MOON:—

Date.	Phases.	H. M.
April 4 ..	● New Moon	11 23 p.m.
,, 12 ..	☽ First Quarter	9 41 p.m.
,, 19 ..	○ Full Moon	1 38 p.m.
,, 26 ..	☾ Last Quarter	11 14 a.m.
April 4 ..	Apogee	9 0 a.m.
,, 18 ..	Perigee	10 6 p.m.

OCCULTATIONS.—The only bright star occulted during convenient hours is η Virginis (mag. 4·0) at 8.18 p.m. on the 17th.

THE PLANETS.—Mercury is an evening star in Aries, being at the most favourable eastern elongation of the year on the 4th, when he sets at 8.30 p.m. He should be looked for immediately after sunset, nearly due west and rather low down. On the evening of the 6th he is 7½° N. of the thin crescent moon. The planet is in inferior conjunction with the Sun on the 23rd.

Venus continues to be a brilliant object in the evening sky during the earlier part of the month, and sets about 10.10 p.m. on the 1st. The planet sets earlier each day, and is in conjunction with the Sun on the 27th. As seen in the telescope, the planet exhibits a crescent which is thinning out but increasing in apparent diameter; on the 15th, 0·05 of the disc is illuminated, the diameter being 55″.

Mars is not in a favourable position for observation, being situated low down in Libra. About the middle of the month he rises at 9.30 p.m. and comes to the meridian at 1.50 a.m.

Jupiter is practically out of range for observation, setting at 8.30 p.m. on the 7th; from this date to June 1st the satellites are invisible, as the planet appears too near the Sun. The moon is near Jupiter on the evening of the 6th.

Saturn is a morning star in Aquarius, rising about 3.45 a.m. near the middle of the month.

Uranus does not rise until after midnight; he is situated low down in Sagittarius.

Neptune is on the meridian before sunset, but is observable in the west until midnight, as he sets about 1 a.m. on the 15th. The planet is near μ Geminorum, and can most readily be found by reference to that star.

	Right Ascension.	Declination.
Neptune (April 15).	$6^h\ 24^m\ 16^s$	N. 22° 21′ 51″
μ Geminorum . .	$6^h\ 17^m\ 13^s$	N. 22° 33′ 38″

METEOR SHOWERS:—

Date.	Radiant. R.A.	Radiant. Dec.	Name.	Characteristics.
	h. m.			
Apr. 17-May 1	16 0	+ 47°	τ Herculids	Small; short.
,, 20-21	17 24	+ 36°	π Herculids	Swift; bl. white.
,, 20-22	18 4	+ 33°	**Lyrid Shower**	Swift.
,, 30	19 24	+ 59°	o Draconis	Rather slow.

Minima of Algol may be observed on the 9th at 11.5 p.m., and on the 12th at 7.54 p.m.

TELESCOPIC OBJECTS:—

Double Stars.—γ Virginis, XII.^{h} 37^m, S. 0° 54′, mags. 3, 3; separation 5″·9. Binary system; both components are yellow, though one is of a deeper hue than the other. An eyepiece of a power of 30 or 40 is required on a 3-in. to effect separation.

π Boötis, XIV.^{h} 36^m, N. 16° 53′, mags. 4, 6; separation 6″. Requires a power of about 40.

ε Boötis, XIV.^{h} 41^m, N. 27° 30′, mags. 3, 6½; separation 2″·7. Very pretty double, with good colour contrast, the brighter component being yellow, the other blue green.

ξ Boötis, XIV.^{h} 47^m, N. 19° 31′, mags. 5, 7; separation, 2″·5. Binary; one component being orange, the other purple.

CLUSTERS.—M 3 *(Canes Venatici)*, XIII.^{h} 38^m, N. 28° 48′. This object, though really a globular cluster of myriads of small stars, appears more like a nebula in small telescopes. It is situated between Cor Caroli and Arcturus, but rather nearer the latter.

ROYAL INSTITUTION.—The following are the Lecture Arrangements at the Royal Institution, before Easter:—A Christmas Course of Lectures (experimentally illustrated and adapted to a juvenile auditory) on Ancient and Modern Methods of Measuring Time, by Mr. Henry Cunynghame; Professor L. C. Miall, Fullerian Professor of Physiology, R.I., Six Lectures on Adaptation and History in the Structure and Life of Animals; Professor Karl Pearson, Three Lectures on Some Recent Biometric Studies; Professor W. E. Dalby, Two Lectures on Engineering; Mr. A. H. Savage Landor, Two Lectures on Exploration in the Philippines; Mr. Churton Collins, Two Lectures on (1) The Religion of Shakespeare, (2) The Philosophy and Significance of "The Tempest"; Professor W. Schlich, Two Lectures on Forestry in the British Empire; Mr. J. J. H. Teall, Two Lectures on Recent Work of the Geological Survey; Professor H. H. Turner, Three Lectures on Recent Astronomical Progress; Professor R. Meldola, Two Lectures on Synthetic Chemistry (Experimental); Sir Alexander Mackenzie, Three Lectures on the Bohemian School of Music (with Musical Illustrations); Mr. D. G. Hogarth, Two Lectures on Archæology; Professor J. J. Thomson, Three Lectures on Electrical Properties of Radio-active Substances; and the Rt. Hon. Lord Rayleigh, Three Lectures on Some Controverted Questions of Optics. The Friday Evening Meetings will begin on January 20, when a Discourse will be delivered by Professor Sir James Dewar on New Low Temperature Phenomena; succeeding Discourses will probably be given by Dr. E. A. Wilson, Mr. Cecil Smith, Mr. J. W. Gordon, Professor H. Marshall Ward, Chevalier G. Marconi, Professor J. J. Thomson, Sir Squire Bancroft, Professor G. H. Bryan, Professor J. Wright, Professor T. C. Allbutt, the Rt. Hon. Lord Rayleigh, and other gentlemen.

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